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Contents:

	PAGE
The "Grid"	179
Electrical Progress in the United States	180
The Contractors' Dinner	180
The E.A.W. and its Objects	181
The Lighting of "the General"	181
Important Amalgamation	181
Electrical-Steel Castings	181
Development in South Africa (*illus.*)	182
Heating Metals by Electricity, by P. Hoho	185
The Physical Behaviour of Lead Sheaths in Relation to Failures of High-Voltage Cables, by C. J. Beaver (*illus.*)	187
Unemployment in 1928 (*illus.*)	189
Domestic Progress and Prospects, by D. J. Bolton (*illus.*)	190
Legal	192
Business and Industrial Notes	193
Lighting and Power Notes	197
Tramway and Railway Notes	198
Telegraph and Telephone Notes	199
Radio Notes	200
Contract Information	200
Forthcoming Events	201
Notes	202
Institution Notes	204
Our Personal Column	204
Financial Section—	
New Companies Registered	205
Official Returns of Electrical Companies	206
City Notes	206
Stocks and Shares	207
Electrical Exports of the United States	209
The E.C.A. Allied Associations	211
The Physical Society's Exhibition.—III (*illus.*)	212
Domestic Electrical Developments (*illus.*)	214
Selected Radio-Telephone Apparatus (*illus.*)	215
The "Grid" Transmission System, by J. Wright and C. W. Marshall (*illus.*)	216
Correspondence—	
The Size of Generating Sets	220
Lamp Trading	220
Load-Levelling	220
Gramophone Reproduction	220
Cost of Running a Private Motor Car	221
Published Specifications	221
Trade Mark Applications	221
New Work for Contractors	222

The "Grid."

THE paper which was read before the Institution of Electrical Engineers last week by Messrs. Johnstone Wright and C. W. Marshall was noteworthy in several respects. In the first place, its presentation bore witness to the disposition of the Central Electricity Board to disclose its plans freely to the electrical engineering profession, and to invite their discussion in public conference—a policy which we cordially welcome. It indicates that a great deal of preliminary work has been accomplished, in reviewing current practice abroad and in selecting and standardising designs suitable for the conditions met with in this country, and includes representative particulars of costs, together with numerous plans and drawings; and it embodies a great deal of labour on the part of the authors, whose hands, we may safely assume, were already well filled with the work involved in the execution of the schemes that are in progress.

In these circumstances, it was unfortunate that, though the theatre of the Institution was filled to the doors by an appreciative audience, the discussion was hardly worthy of the occasion. Mr. W. B. Woodhouse, in opening the discussion, certainly raised a number of interesting points, and incidentally mentioned that with the approval of the Electricity Commissioners he was erecting, in a part of his company's area, an experimental section of four-phase transmission line, in accordance wth the system which he advocated in our pages last year (Elec. Rev., February 17th, 1928, p. 269); but otherwise the debate was disappointing.

Turning to the paper, we note that the authors recognise the fact to which we have drawn attention on previous occasions, that the British "grid" differs from the extended networks which are employed abroad, in that the latter are almost always used for transmitting large blocks of energy from natural sources to remote consuming points; in this country, with sources of energy widely distributed over almost the whole area, there is no need for long-distance transmission, and the functions of the grid are practically confined to co-ordinating the operation of the generating stations with a view to improving load factors, and to reducing the amount of spare plant required locally. These functions are also served by the Continental and American networks, with advantageous results, as evidenced by the fact that in almost every instance those networks have

been built up in private ownership by gradual extensions; in that respect they are in contrast with the British grid, which is unique in that it has been conceived and will be constructed as a complete national reticulation *ab initio*. It is also unique in its third function—that of acting as the great reservoir into which all the electricity generated will (at least, in theory) be poured and from which it will be resold by the Board; in actual practice, no doubt, the bulk of the energy will as at present be distributed locally, appearing only in the Board's books and not on the grid.

The choice of steel-cored aluminium cables is satisfactory, not only on technical grounds, but also on the score of their constituents being home products. Up to the present the Board has placed all its contracts in this country, and we hope that it will rigidly adhere to that policy. The same remark applies to the steel towers, and we note with interest that the use of reinforced concrete has been considered; whilst the authors very definitely decide in favour of steel for the high towers of the grid, ferro-concrete may well prove worthy of adoption for the secondary lines, and both steel and cement are British products.

A noticeable feature of the paper is the definite tendency towards simplification which is indicated in various relations, and which is highly commendable.

Electrical Progress in the United States.

THE first issue of the year of the *Electrical World* is always devoted to an exhaustive examination of the past, present, and future of the electrical industry in the United States, and as that country unquestionably is the world's greatest user of electricity, this annual review contains many items of exceptional interest to all electrical men. No less than 4,576 millions sterling is invested in American electrical undertakings, nearly half of which gigantic sum is allocated to electricity supply, on which 290 millions of new capital was spent last year.

The output of electrical energy generated in 1928 was 83,100 million kWh, an increase of 10 per cent. over the previous year's record; the energy sold amounted to 69,700 million kWh, showing a loss in transmission, &c., of 16½ per cent. Two-thirds of the output was sold for motive power, one-fourth for lighting, &c., and one-tenth for traction; the power sales showed the greatest increase. Sixty per cent. of the total energy was generated from fuel, and forty per cent. from water-power, though the capacity of the hydro-electric plant was only 28 per cent. of the total—the water being, of course, utilised as fully as possible. It is pointed out that whilst the earlier hydro-electric stations cost less than £40 a kilowatt, most of the sites still undeveloped would probably require an average outlay of £80 a kilowatt, as against £18 for steam stations, which could also be built near the centres of utilisation, eliminating the cost of transmission—hence the development of water-power is likely to slow down in future.

The gross revenue of this gigantic industry was 382 millions sterling, of which 56 per cent. was contributed by the lighting branch and less than 30 per cent. by power consumers, almost in inverse ratio to the respective amounts of energy consumed; hence the average price obtained per kWh for lighting, &c., was 3.15d., and for power 0.7d., the average all-round being 1.37d.

It is editorially pointed out that the main problem now before the industry is "to intensify the use of electricity for present services," by the development of domestic business and of electric heating in industry—two fields which we also are cultivating, though by no means so strenuously as we should. There are over 23 million lighting and power consumers in the United States, of whom 19 millions are domestic consumers. The average use of domestic energy per consumer, in the case of a group of 41 "utilities," was 473 kWh in 1927; but it is estimated that the figure can be increased to 3,000 kWh by aggressive sales campaigns. "The refrigerator, range, water heater and other little-used electric services must be sold in volumes hitherto unknown . . . above all, the domestic customers must be educated in the use of the new services."

There are no fewer than 4,063 electricity supply undertakings in the United States, of which 1,910 are municipal and 2,153 are in private hands; the former, however, are of small size, aggregating only 1½ million kVA. As generating undertakings, the municipalities are insignificant, 95 per cent. of the energy used being produced by 1,274 privately-owned undertakings, with plant of over 30 million kVA capacity—an average of 23,700 kVA. Some 2,000 undertakings purchase all the energy they distribute. There are 2,726 undertakings with generating plant of less than 500 kVA.

During the year the number of operating systems diminished by 387, owing to the tendency towards consolidation. It is significant that the internal-combustion engine is credited with the inauguration of new municipal undertakings in isolated communities.

It is estimated that industrial motive power supplied from central stations is 18½ million h.p., nearly half the total horse-power installed in industries, and another 10½ million h.p. is electrically driven. The motive power used in industry is reckoned at over 4.7 h.p. per wage earner, of which at least 3.5 h.p. is electric. Some 350,000 farms receive a supply of electricity—an increase of over 125,000 in three years. Finally, taking the population at 125 millions, the average consumption of central-station energy per capita appears to be about 556 kWh per annum for lighting, power, and traction—probably about twice as much as in this country, from all sources.

The Contractors' Dinner.

THE presence at last week's dinner of the E.C.A. Allied Associations of Col. Ashley (who had charge of the Electricity Supply Act, 1926), Mr. Frank Hodges (a member of the Central Electricity Board) and Mr. T. P. Wilmshurst (an Electricity Commissioner) would seem to indicate that the electrical hierarchy is aware of the importance of the electrical contractor to the national electricity scheme. This view was expressed by the speakers to the toast list, who acknowledged the contractor's position as the ultimate connecting link between the supply and manufacturing branches of the industry and the public.

Col. Ashley made reference to the excellent electrical progress made in this country during the last few years, and spoke highly of the work of the E.C.A. in bringing together the various sections of the industry. A large part of his speech was devoted to the subject of rural electrical development, and he intimated that a scheme for testing the rural demand might shortly be put into operation.

The President (Mr. W. H. Walton) claimed that the Association considered that its greatest work was the fostering of good relationships between manufacturers, supply authorities, and other electrical interests. It was also the aim of the Association to raise the standard of installation work. He added, lest it should be thought that the Association was entirely altruistic, that it also endeavoured to secure a fair measure of remuneration for its members. Mr. Walton also stressed the danger of bad installations, and again expressed the view that contractors should be required to possess some definite qualification, or that there should be compulsory regulations.

Lt.-Col. Edgcumbe (president of the I.E.E.) acknowledged that the whole of the electrical industry was dependent upon the contractors—"ambassadors of electricity"; they had a great responsibility to the public, and they were right in insisting on high-grade work. Mr. Wilmshurst, too, stressed the need for every endeavour to raise the standard; in his 30 years of electricity supply work he had frequently met appalling examples of shoddiness.

All well-wishers of the industry will agree with these views and back up the E.C.A. in its efforts, which have extended over more than 27 years, to improve the status of the contractor by insisting equally on good installation work and on adequate payment for it.

The E.A.W. and its Objects.

OUR readers will have noticed the frequency of our recent references to the events organised by the Electrical Association for Women. The 1928-29 season promises to be the most successful it has had. It may be pointed out that the Association differs fundamentally from all other electrical associations in that its objects are purely altruistic. The only axe it has to grind is that of the common weal: it aims to educate the public, especially the all-important female public, in the application of electricity to the common things of life, and thereby to lighten the labour of the long-suffering housewife. The only benefit that the members themselves secure, apart from the satisfaction of doing others a good turn, is the increase of their own knowledge that results from teaching their friends, and from the lectures, demonstrations, and visits to works and installations which are organised by the Association. Its growth has been phenomenal; already its membership is more than 3,000, and healthy branches have been set up at numerous provincial centres. One was opened last month at Bristol, when Mr. Faraday Proctor appropriately took occasion to remind us what useful service women rendered electrically in situations of responsibility during the war; and another is to be opened at Gloucester.

The work of the Association incidentally, but very materially, benefits the electrical industries also, by inspiring interest in electrical subjects and promoting the use of electricity and electrical appliances. It helps to dispel the mystery which too long has enveloped electrical things, and to enable the housewife to deal with those minor repairs and adjustments from which no public utility service is immune—much easier to effect efficiently in the electrical sphere than, say, the replacement of a broken gas mantle and chimney, or the renewal of the washer in a water tap. In a word, it seeks to popularise electricity; and its members are peculiarly fitted for that task, as they understand the mentality of the housewife and can enter into her difficulties better than any male instructor. They also appreciate the nicer points of the domestic arts of cleaning, cooking, washing, and ironing, and are familiar with the weaknesses and strength of electricity's competitors. To support the E.A.W., therefore, should be a cardinal principle with electrical men.

The Lighting of "the General."

CAN anybody explain why the exterior of the chief Post Office of the metropolis of the world should be so badly lighted? The lack of illumination is particularly noticeable late in the afternoon of any business-day at this time of the year. The rush hours for making counter purchases and for posting in the outside boxes in King Edward Street would seem to call for good lighting not merely for ordinary convenience but for the public safety at the entrance steps as well. It is true that at the edge of the wide pavement there are two gas lamps which serve to prevent one on a foggy day from blundering into the statue close by. There are also two similar standard lamps without burners, while one wall lamp is fixed at the mail van entrance; but surely electric lamps could be placed over the doorways and near the posting boxes, and a better lighting of the thoroughfare generally could be provided. However pleasing the interior lighting, it does not provide suitable outside illumination for those who have every day to make use of this very important building. It is strange, in days when, generally speaking, a brighter London is in vogue and brilliant illumination of shops, stores and thousands of thoroughfares is considered indispensable, that some of our biggest public buildings are still living in the dark ages. There may be good reasons for a great Cathedral remaining in silent and impressive darkness—but a Post Office, *the* Post Office, indeed!

Important Amalgamation.

WE announce in our "Business Notices" to-day another amalgamation of manufacturing companies prominently connected with the British electrical industry. Messrs. Laurence, Scott & Co., Ltd., of Norwich, whose business was established 45 years ago and who have been producing a wide range of electric generating plant and motors, as well as electrical equipment of all kinds for ships, are joining hands with one of the most progressive and reputable producers of electric motor and other industrial plant—Electromotors, Ltd., of Openshaw, which company was formed in 1899. They will operate in combination under the title of Laurence, Scott & Electromotors, Ltd. (L.S.E.), with a total capital of £310,000, all in ordinary shares, and of course therefore with no "charges" whatever thereon. We understand that the underlying feature of this amalgamation is a belief that the future hope of the British engineering industry lies in the continuance of the policy of maintaining that high standard of design and quality for which British producers have hitherto been renowned.

Electrical-Steel Castings.

AT several of the joint meetings of the Glasgow and West of Scotland Branch of the Institution of Mechanical Engineers and the Institute of British Foundrymen held recently, the scope and defects of steel castings have been discussed, and it was pointed out by one speaker that certain Continental foundries were able to maintain a position in the markets of this country; in the case of motor-vehicle parts, such as axle casings and wheels, this market continues in spite of the 33 per cent. import duty. Whether certain differences in technique, such as the use of the electric furnace, are responsible for this state of affairs, or not, it is interesting to note that Messrs. Leyland Motors, Ltd., have installed electric steel-melting furnaces and that there is a brisk demand for the surplus capacity of the furnaces from other branches of the engineering trades.

It is generally agreed that it is possible, and even easy, to spoil steel in the electric furnace: nevertheless, that type of furnace, if well used, is capable of yielding material which is hard to surpass even with the products of the crucible. "In these circumstances," as one expert said some time ago, "it is unfortunate that, partly as a result of trade depression, but also to a considerable extent owing to a set-back on technical grounds, so many of the electric furnaces installed during the latter part of the 1914-18 war period have fallen entirely out of use." For steel melting the arc furnace is in general use, several variations of the arc arrangement being employed. The electric furnace possesses the advantage of being able to maintain a reducing atmosphere as and when required, which, along with marked basicity of the slag, enables a certain degree of sulphur removal to be accomplished with a fair certainty of success, a characteristic not possessed by any other method of melting. Trouble in the electric melting of steel can usually be traced to inexperienced labour; the steel is exceptionally pure and it lacks the fluidity of a steel rich in impurities. Hence, it requires great care and skill to teem a large number of castings without either leaving a skull in the ladle or experiencing stopper rod trouble. It is very bad practice to pour the steel at a very high temperature because the percentage of cracks is certain to be high and, further, fettling becomes a difficult operation because the sand becomes burnt into the metal. The electric furnace, properly used, has no equal for steel melting, except the crucible for small quantities of metal, and the future position of the steel-castings industry should not be much in doubt, because in actual practice British foundrymen have not much to learn from their Continental competitors.

Development in South Africa.

A review of the activities of the South African Electricity Supply Commission, and notes on the working and equipment of the five undertakings under the Commission's jurisdiction.

By OUR SPECIAL CORRESPONDENT.

THE development of the generation and distribution of electricity in South Africa has undergone a number of changes since the establishment of the Electricity Supply Commission, which came into being as the outcome of the Electricity Act of 1922. The members of the Commission are Dr. H. J. Van der Bijl (chairman), and Messrs. J. R. Fulton, A. M. Jacobs and K. Gundelfinger; their headquarters are at Johannesburg. In 1923 the Commission decided to establish a generating station at Witbank, in the Transvaal, and since then other stations have been established at Sabie in the Transvaal and Salt River in the Cape; other activities of the Commission include the taking over from the South African Railways of the Natal Central undertaking, containing 22 sets of motor generators, with a total rated capacity of 44,000 kW, and six traction sub-stations containing 12 sets of rotary converters, with a total rated capacity of 24,000 kW.

The following table gives the comparisons of the various undertakings to December, 1927:—

Undertaking.	Capital Exp.	Capacity in kW.	Units sold in 1927.
Witbank ...	£1,514,257	60,000	439,061,782
Sabie ...	108,981	1,700	1,938,940
Colenso ...	3,239,920	60,000	104,206,235
Capetown ...	1,247,010	30,000	5,811,836
Durban ...	494,866	36,000	—
Total	£6,605,034	187,700	551,018,733

The Witbank undertaking is situated in the Middle

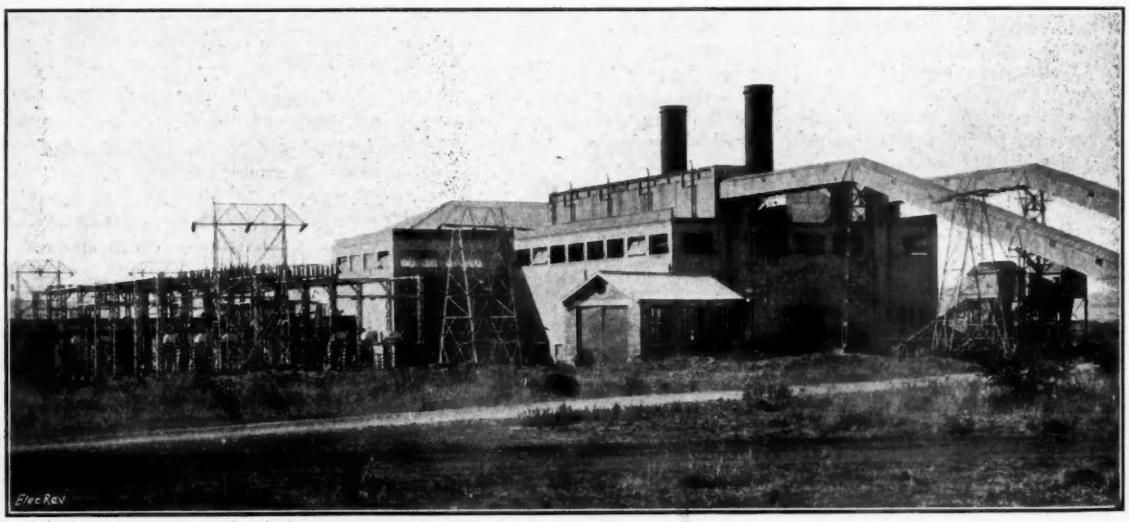


Fig. 1.—Colenso Electricity Works and Step-up Sub-station.

including a power station of 60,000 kW at Colenso, and the provision of the Congella station at Durban.

In addition to these stations, a very large programme of work has been accomplished in connection with various schemes of local authorities on which the Commission is called upon to report before sanction can be obtained for the adoption of new schemes, or extensions.

The total capacity of the plant at present installed, or on order, for the Commission's five undertakings amounts to 209,000 kW, and is made up of 22 sets varying in size up to 20,000 kW. The total boiler capacity is equal to 2,250,000 lb. per hour, from 35 boilers.

The following table shows the route mileage of the various transmission lines and cables in use at the moment at various voltages:—

	88,000 v.	33,000 v.	22,000 v.	Below 22,000 v.	Total.
Overhead lines ...	275	71	30	8	384
Cables	—	29	8	6	43

Of transformers there is installed a total of 300,000 kVA, while there are 12 traction sub-stations

burg district of the Transvaal, near the Great Oliphants River and in the heart of the principal coalfield, so that both fuel and water are obtained at the minimum cost. The station was constructed by the Victoria Falls and Transvaal Power Co., Ltd., for and on behalf of the Electricity Supply Commission, and is operated by it under an agreement between the two parties; the largest consumer is the Victoria Falls and Transvaal Co., which consumes approximately 400 million kWh per annum The station, fig. 2, from which electricity was first supplied in May, 1926, was put into commercial service in July, 1927, the plant consisting of three 20,000-kW Parsons reaction steam turbo sets, generating at three-phase, 50 cycles, 6,600 V, and 12 Babcock & Wilcox boilers, each with an evaporative capacity of 70,000 lb. per hour. A fourth and similar generating set and three extra boilers are now being installed, and will bring up the total capacity of the station to 80,000 kW.

Water for the boilers and condensers is pumped over a distance of approximately 6 miles, with a lift of 900 feet, to a reservoir from which it gravitates into the power station. The requirements necessitated

building a dam across the Oliphants River to give a storage capacity of 1,300 million gallons. The condensing water is cooled in spray ponds, each machine using a pond two acres in extent. The maximum hourly demand on the station in 1927 was approximately 61,000 kW, the load factor being 82.2 per cent., while the coal consumption worked out at 1.75 lb. per unit generated; the average thermal efficiency was 16.2 per cent. Voltage is stepped up at an outdoor sub-station, fig. 2, adjacent to the power station to 132,000 V, for transmission to the Rand through 60 miles of the Victoria Falls Co.'s overhead lines.

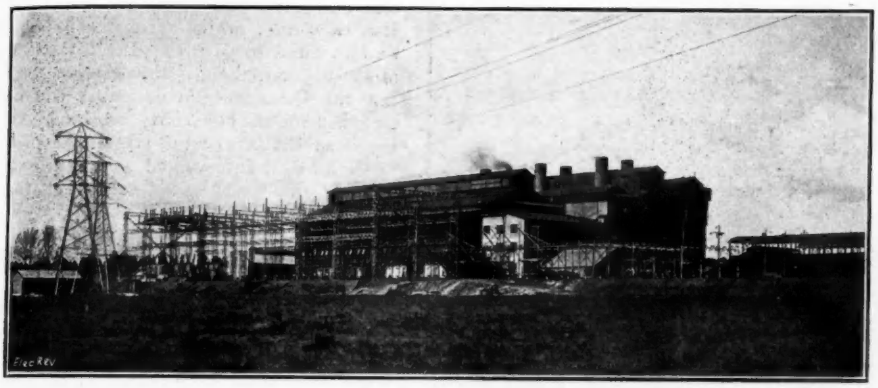


Fig. 2.—Witbank Generating Station, Sub-station, and Transmission Lines.

interconnected at Brakpan, thus establishing a regional system comprising five generating stations with an installed capacity of 398,000 h.p. The other consumers, besides the V.F.P.C., are the Rand Carbide Co., six collieries, and individual consumers in Witbank Municipality, these being supplied from a 21,000-V overhead transmission line 20 miles long and 8 miles of cable.

The standard tariff is as follows:—

(*a*) A standing charge of £25 per annum.

(*b*) A charge of £6 per annum per kVA of maximum demand, reduced to £5 10s. since July last.

(*c*) A charge of .06d. per unit.

The supply to the V.F.P.C. is governed by a special agreement.

The Sabie undertaking is situated in the Pilgrim's Rest district of the Transvaal, about 8 miles from the Sabie township. Though only a small plant it was established to meet the requirements of the group of Gold Mines in that locality, and so urgent was the need for an increased supply that a temporary hydro-electric plant of 350 kW was put down in 1925 until the main hydro plant at the Gorge on the Sabie River was first put into operation in 1927, after which it acted as a stand-by plant for a time. The temporary plant consisted of one wheel taking 8 cusecs and generating at three-phase, 500 V, 50 cycles. The Gorge station, which was put into commercial service in April, 1928, contains three spiral casing reaction turbines, by James Gordon, rated at 688 h.p. each, with a net operating head of 200 feet, each wheel taking 35 cusecs normally. The turbines are directly coupled to 450-kW A.S.E.A. generators, three-phase, 3,300 V, 50 cycles, 750 r.p.m. The site of the dam is about 4,000 feet up-stream, and water is led to the power station through a combination of three tunnels, 1,980, 1,520 and 950 feet long respectivley, two short aquaducts, a flume 1,200 feet long, and a 42-in. penstock about 550 feet long, together with the necessary sand traps, siphons, and so on. Fig. 3 shows the weir and intake of the Sabie Gorge station. Voltage is stepped up to 22,000 V by three single-phase transformers of 400 kVA each, forming a 1,200-kVA bank, feeding into an overhead transmission line running for 7 miles over broken country into the Sabie township, where it is stepped down again in an outdoor sub-station to 3,300 V for local distribution to the near-by Gold Mines.

The Natal Central undertaking at Colenso was first established by the South African Railways Administration in connection with the electrification of the Glencoe-Pietermaritzburg section of the Natal main line, and was taken over by the Commission in January, 1927, together with its 275 miles of overhead transmission lines and 12 semi-automatic sub-stations. The power station, fig. 1, is situated on the bank of the Tugela River, near the Colenso Railway Station, and the plant consists of five 12,000-kW Parsons reaction turbo-alternators, three-phase, 6,600 V, 50 cycles, 3,000 r.p.m., and eight Babcock and Wilcox 60,000-lb. water-tube boilers working at 270 lb. per sq. in. and 700° F. superheat. The coal consumption works out at 1.63 lb. per unit generated. The maximum half-hourly demand for the past year was 25,600 kW, with a load factor of 50.6 per cent. and a thermal efficiency of 16 per cent., which is highly favourable as the railway load is very variable, being subjected to sudden and violent fluctuations of as much as 20,000 kW in a few minutes at any hour of the day. At an outdoor step-up sub-station, fig. 1, located near the power station, the pressure is raised 88,000 V by 13,500-kVA transformers of the International General Electric Co. From this point duplicate overhead transmission lines of a total length of 275 miles extend in two directions, feeding into the various sub-stations for the electrified railway and supplying

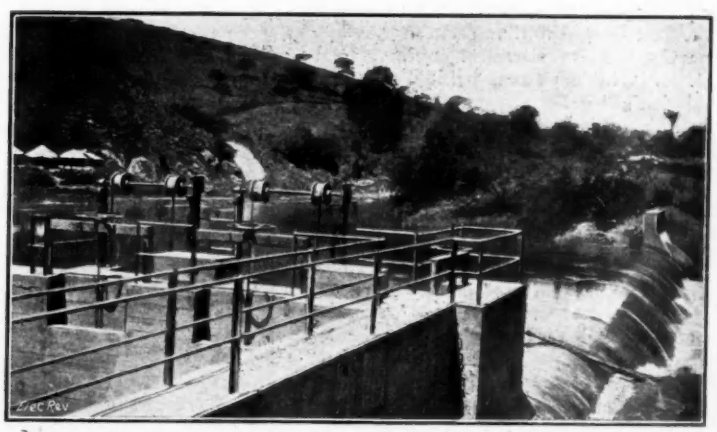


Fig. 3.—Weir and Intake for Sabie Gorge Scheme.

other consumers along the route. The sub-stations, of which there are twelve in number, are situated at intermediate points between Glencoe and Pietermaritzburg; some of them are used also for the supply to Glencoe Local Board, Ladysmith, Estcourt and Pietermaritzburg Municipalities. A few other individual consumers and further applications are now under consideration. The sub-stations are equipped with outdoor step-down transformers for supplying 2,000-kW motor-generators at 6,600 V. These machines give the 3,000-V d.c. supply for the railway. The equipment is

semi-automatic, with push-button control from signal cabins. Special arrangements have been made for the correction of the power factor, which it is possible to maintain at practically unity at all loads.

The standard tariff adopted is as follows:—

(*a*) A fixed charge of £150 per annum payable in advance, plus,

(*b*) A charge of £5 per annum per kVA of maximum demand.

(*c*) A charge of 0.3d. for the first 1,000,000 units per annum, 0.2d. for the next 2,000,000 units, and 0.15d. for all additional units.

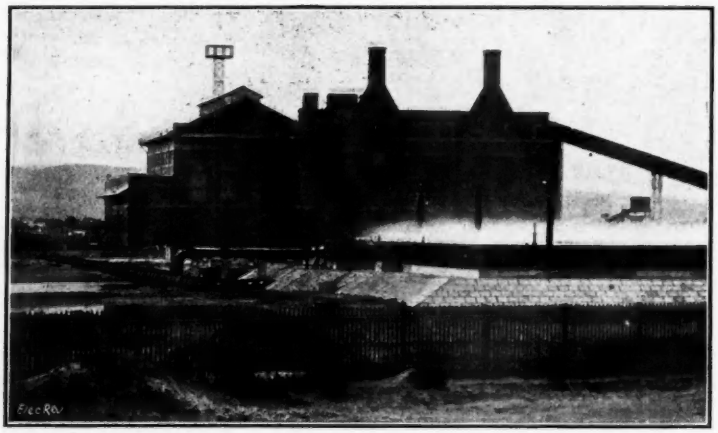


Fig. 4.—Salt River, Cape Town, Commission Power Station.

Special charges are in force for the Railway Administration.

The Cape Town undertaking was established mainly with the object of supplying the Cape Suburban Railways (Cape Town-Simonstown and Cape Town-Sea Point), the Salt River railway workshops, grain elevators and other services at the Docks, as well as a supply for the rural districts, and also to assist in meeting the demands of the City of Cape Town by linking up with the Municipality's Dock Road power station. In connection with the latter, an agreement was entered into between the Commission and the Cape Town Municipality in April, 1924, and to ensure the best co-ordination between the two parties the city electrical engineer (Mr. G. H. Swingler) was appointed the Commission's local manager in charge of both power stations, which are interconnected by duplicate underground cables, the municipal power station having been modernised during the past few years and brought up to a relative high efficiency.

The Commission's power station, fig. 4, is situated at the estuary of the Salt River and within two or three miles of the centre of the City. Condensing water is taken from Table Bay, and its provision presented a very difficult problem, as precautions had to be taken against exposure to the ocean and to prevent sand from entering the circulating-water system. Pipes were laid just under the ocean bed 1,300 feet out to sea, communicating with an intake tower through which water is admitted well above the sand level. The station plant consists of three 10,000-kW turbo-alternators, of the Howden Zoelly type with E.E.C. alternators, 12,000-V, three-phase, 50 cycles, 3,000 r.p.m., with surface condensers by Mirrlees Watson and Co., and four 60,000-lb. Babcock & Wilcox boilers working at 270 lb. per sq. in. with 700° F. superheat. The boilers are fitted with tubular type air pre-heaters operated under balanced draught. A step-up sub-station containing 6,000-kVA outdoor-type transformers raises the pressure to 33,000 V for the supply of power to the Railway Administration for the Cape Town-Simonstown and the Sea Point sections of the South Africa Railways, by means of both underground cables and overhead lines, and the supply is stepped down and converted to 1,500 V d.c. for the railway track at six automatic sub-stations, by means of 2,000-kW rotary convertors.

There is also a 33,000-V overhead transmission line 71 miles in length erected through the rural districts, supply being given to the Paarl Municipality, the Cape Explosives Works at Somerset West, and other industries and local authorities *en route*, while arrangements are now in hand to give supplies to several other municipalities, thus accomplishing the Commission's desirable aim of securing for all electricity consumers in the area the benefits of large-scale production at the interlinked power stations of the Cape Town Municipality and the Commission.

The latest of the Commission's undertakings is the Congella power station at Durban, fig. 5, which is shortly to go into commercial service and is unique in being the first South African plant designed for the use of pulverised fuel. A new station at Congella was erected by the Commission on account of the decision of the Government to electrify the Durban-Pietermaritzburg section of the Natal main railway line, and also because the Corporation of Durban was contemplating establishing a new power station as demands had outgrown its existing generating plant. This section of the railway electrification was, however, deferred at the last minute, it being decided to electrify the northern section of the line first, for which reason the Colenso undertaking was established. In time the stations at Colenso and Congella will no doubt be interconnected, the Commission's existing transmission lines from Colenso terminating at Pietermaritzburg, some 50 miles away from Congella.

An agreement was entered into between the Commission and the Durban Corporation in April, 1925.

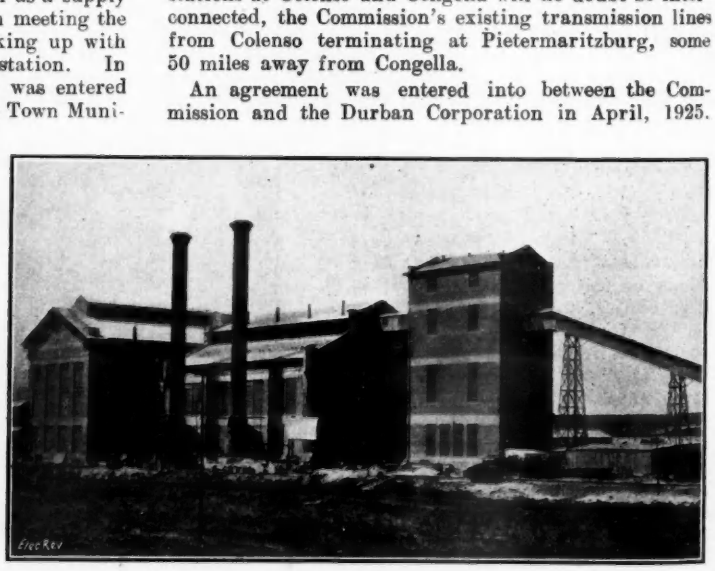


Fig. 5.—Congella Powdered-coal Power Station at Durban.

for 30 years, whereby the Corporation will take a minimum of 60 million units per annum, exclusive of the load required by the Government for its railway workshops, coaling appliances, dock, grain elevator, and so on, with a maximum demand of 14,000 kW. A somewhat similar arrangement was made as at Cape Town, whereby the borough electrical engineer (Mr. John Roberts) was appointed local manager for the Commission as well, but in Durban's case it is the intention to close down the municipal power station as

soon as convenient, leaving the municipality with the work of distribution, including the town itself and an area within 16 miles radius outside the municipal boundary.

The power station is situated near the head of the Durban Bay, from which circulating water is taken, and is designed for an ultimate capacity of 72,000 kW. The present plant consists of two 12,000-kW Parsons turbo-alternators, 6,600 V, three-phase, 50 cycles, and six 60,000-lb. Babcock & Wilcox boilers generating steam at 270 lb. per sq. in., superheated to 700° F. The boilers are fired on the "Lopulco" system of pulverised coal, and for this reason the efficiency of the undertaking will be watched with great interest by all engineers. As soon as possible after the station goes into operation it has been arranged to transfer to the Commission's power station two 6,000-kW turbo sets from the municipal power station. The tariff to the Durban Corporation is £5 8s. per annum per kW of maximum demand, plus 0.2d. per kWh of electrical energy consumed.

In addition to the larger undertakings briefly referred to in the foregoing, the Commission, up to December, 1927, has reported on no fewer than 117 electricity schemes, and it is interesting to note that there are no fewer than 147 local authorities in the Union, either owning electricity schemes, or with schemes in course of construction.

Heating Metals by Electricity.

A Special Process Adapted for Welding, Hardening, and Other Industrial Operations.

By PAUL HOHO.

ALTHOUGH not well known, there exists an electro-thermic phenomenon in connection with the passage, under certain conditions, of a current of electricity from a solid to a liquid. The phenomenon appears to have first been made known as long ago as 1844 by Fizeau and Foucault in connection with experiments on the intensity of the light produced by the electric arc. Since then various scientists have referred to it, Violle and Chassagny having dealt with it exhaustively at the Société Française de Physique in 1889; reference may also be made to Markrell & Hare, Van der Willingen, Slouginoff, Righi, Colley, & Planté.

During the period 1891-93, Mr. E. Lagrange, in conjunction with the present writer, presented several papers to the Académies des Sciences of Belgium and of France, the purpose of which was to determine the causes and the working of the phenomenon in question and the conditions which brought it about. In the course of our research we found that there were various phases of the phenomenon which, while following one another, possessed distinct characteristics and properties.

Thus, when the solid consists of a metal, it may be heated to any desired temperature; moreover, such metal can be subjected to all operations requiring preliminary heating, such as forging, welding, tempering, annealing, hardening, &c., so long as these operations are carried out under special conditions particularly favourable thereto.

General Principles.

The principle and the essential characteristics of the process may be briefly summarised thus:—If in any suitable vessel, either of glass or refractory material, containing a liquid conductor, such as dilute acid, or a saline solution—sulphuric acid or potassium carbonate—a fairly large metal plate connected to the positive of a source of d.c. electricity is plunged, the plate will become a positive electrode. Take, for example, the case of a liquid consisting of weak sulphuric acid such as is used in accumulators, or a 5 to 10 per cent. (by weight) solution of potassium carbonate, and a round bar of metal from 1 to 2 cm. in diameter; when the latter is connected up to the negative of the source of electricity and is slowly lowered into the liquid to a depth of several centimetres, on slowly increasing the voltage of the current it will be noticed that (1) so long as the e.m.f. does not exceed a certain value, in general, a few dozen volts, according to the conductivity of the liquid, all that occurs is the decomposition of the water, hydrogen being given off on the negative, and oxygen on the positive side. (2) On increasing the e.m.f., at a certain moment sparks will occur between the metal bar and the liquid, together with a slight irregular boiling of the liquid in contact with the metal. During this period the intensity of the current varies between wide limits, the average being relatively high. This may be called the "unstable" period. (3) If the e.m.f. be further increased it will be found at a certain moment that there is formed round the bar of metal in the liquid a gaseous layer or sheath, the sheath being not only luminous, but also clear and circumscribed, forming a distinct separation between the metal and the liquid, across which the current has to pass. In this case, however, the current remains not only steady, but relatively small also. This is the "stable" period. The sheath above-mentioned consists of the hydrogen of the water vapour and the positive element of the salt in solution. The colour of the sheath depends on the nature of this positive element; if it is an acid solution, the colour will be pale violet, owing to there being only hydrogen with the water vapour.

As a result of the action of the nascent hydrogen, some de-oxidisation and scaling of the metal occurs; at the same time the electrical current has another action, removing instantaneously, and in a measure mechanically, all the surface impurities, the surface of the metal undergoing, together with the scaling, a thorough cleaning.

The thickness and stability of the sheath increase with the e.m.f., its electrical resistance and consequently the amount of heat generated by the passage of the current also increasing.

The foregoing results can be obtained with lower e.m.f. in proportion as the conductivity of the liquid is increased. At a certain moment the iron will become red hot, then white, and will finally melt in the liquid. To give a concrete example, with a potential difference of 200 volts at the terminals and an 8 per cent. solution of potassium carbonate, a round bar 1 cm. in diameter can be heated to the melting point in less than two minutes.

The intensity of the heating for a given e.m.f. can be reduced by lowering the conductivity or strength of the liquid. At all times, however, it is possible to regulate the action by simply varying the e.m.f.

In the case outlined above the current density at 200 volts will be about 3 amperes per sq. cm. of the surface of contact between the metal and liquid. By the use of insulators, referred to below, the current can, however, be reduced to 1½ amperes.

The Use of Insulators.

It is obvious that if part of the surface of the metal plunged in the liquid is covered with an insulator, no current will pass at that part and the protected portion of the metal will not be heated. In this way it is possible to secure "local heating."

It is not necessary that the insulation shall be absolute. To protect a part of the metal against the calorific action, it is sufficient to fix near that part an insulator. For example, a porcelain tube will perfectly protect a metal bar within it if the diameter of the bar is slightly less than that of the tube. This also follows from the fact that the electrical resistance of the liquid is very high. In the above-mentioned solutions and in those employed in practice the resistivity ranges from 1 up to 50 megohms.

In the same way an insulating plate arranged a few millimetres away from a metallic surface will protect the latter almost completely, according to the area of the surface and the distance between the metal and the insulator.

Generally speaking, the insulators may be applied in a multiplicity of ways, according to the portions to be heated, and the parts to be protected; usually they are located in the electrical circuit within the liquid at points where they can reduce the amount of current passing at any predetermined part of the metal. Very often they take the form of screens which reduce the liquid sections through which the current must pass to reach predetermined parts of the metal, or, again, the length of the electrical circuit can be extended.

Thus by the judicious use of insulators not only can the heating be restricted to clearly-defined, predetermined parts of the metal, but the degree of heating at one point or another can also be controlled.

A current of electricity seeks the path of least resistance between the two electrodes. If between the latter is interposed a piece of metal, the current will frequently pass through the metal, which may, indeed, under certain conditions, depending largely on its size, become the seat of calorific action such as that described above without, however, there being any direct connection with the source of electricity.

Before dealing with the practical applications of the process, a few lines may be devoted to the question of the use of insulators. When the insulator is not in direct contact with the metal, there is a certain loss of current between the two bodies, the amount of loss depending on the elements forming the electrical circuit in the liquid, and the electrical resistivity of the latter. When the insulator is simply applied to the metal without being fixed to it—as, for example, an insulating plate fixed above the surface of the metal or an insulating tube surrounding the metal bar—liquid passes into the interstices between the two bodies, allowing the passage of current. However small this may be, it can be reduced by using either on the metal or the insulator a liquid, semi-liquid, or pasty insulating material or powder, such as oil, grease, or even sand, which will partly fill up the space between the metal and the insulator.

Attention may here be drawn to two points. When a bar of metal is plunged into the liquid, heat is generally given off at the point of contact of the metal and liquid; the electrolytic action also causes gas to be given off, this resulting in the level of the liquid being agitated, and being irregularly splashed by the agitation on to the uncovered metal. The result is that momentary contacts are formed between the liquid and the metal, causing waste of electricity by giving rise to parasitic currents. By covering the metal to a certain depth below the level of the liquid by means of an insulator, these currents can be avoided and, as has been shown, the power used can be reduced by half, or in the instance given from 600 to 300 watts.

As the calorific action of the electric current takes place on the surface of the metal, the edges and many points on the latter become heated more rapidly than the remaining portions—a tendency which can be avoided by the judicious application of insulators. Thus the end of a bar can be protected by simply placing it on a small insulating plate, or allowing it to pass a little way into a sufficiently wide insulating tube. Daily practice will reveal to the operator many simple ways, varying according to the circumstances, to overcome the difficulty.

Applications.

From the foregoing remarks it will be seen that the method of heating metals outlined is not only applicable to all metallurgical operations in which preliminary heating is requisite, but in a quite special and advantageous way; indeed, it lends itself to operations hitherto unknown or impossible. To summarise: (1) by the action of the hydrogen formed at the negative pole the metal is heated in an essentially reducing or deoxidising medium, and at the same time is scaled by the action of the electric current; (2) the degree of heat can be adjusted by a hand regulator varying the e.m.f.; (3) the heating may not only be restricted to any predetermined parts of the metal, but may also be varied as desired between one point and another; (4) as the calorific action is brought about within the liquid by the electric current, this can be cut off at any time to instantly stop any further heating, so that it is possible to temper or harden metal capable of such treatment, without any additional handling.

As a result of these special advantages—immediate hardening or tempering directly following the heating without changing or altering the position of the metal—a much wider range of hardening or tempering possibilities than has hitherto been available is secured; not only so, but the control is rendered greater by reason of the possibility of varying at will the heating from one point to another. Indeed, just as the strength of current, and consequently the rapidity of the heating, can be varied, it is possible to switch off the current when the outer portion of the metal to a certain depth has been brought to a red heat, the interior remaining below the hardening or tempering temperature, and its fibrous structure remaining consequently undisturbed.

Electrolytes.

Generally speaking, any conducting liquid may be used, but more especially acids and salt solutions. By the electrolytic action of the current the positive elements of the electrolyte—the hydrogen and metals—are transferred to the negative pole, while the negative elements are carried to the positive, or, as it may be termed, the "passive" pole. In the heating operation hydrogen in a nascent state constitutes the principal element of the gaseous sheath which forms round the metal, and which may burn at the surface. The atoms of the other metals of the electrolyte also enter the sheath in a nascent condition, as is shown by spectroscopic examination. According to their character they may also burn at the level of the liquid round the metal, but, under certain conditions, they may also adhere to the electrode, *i.e.*, the heated metal.

In view of this it is possible to heat iron or steel in solutions of salts of iron, either non-acidulated or acidulated, particularly for welding purposes. Moreover, it is also possible to heat iron and steel for welding purposes in solutions of salts of manganese, nickel, chromium, or other metals, in order to introduce these metals in a nascent state into the operation. The same reasoning may be adopted in connection with the welding of other metals, particularly aluminium and copper, which can be heated in salt solutions of the same metals, or, according to the result desired, in solutions of the salts of other metals.

The point may here be raised whether in welding operations, one or other metal should not be introduced, it being possible that such metal deposited by the electrolyte may play a certain rôle. It is also possible that, in certain circumstances, it may be advisable, before the heating operation, to submit the metal purely and simply to electrolytic action by reducing the strength of the current for a certain period of time during which the metal is only moderately heated, so causing a deposit

on the metal of particles of any desired metal before the actual welding.

Briefly summarised, the process enables metal to be welded in an atmosphere of hydrogen mixed with atoms in a nascent state of any desired metal. In the second place, it enables the welding operation to be preceded by a more or less prolonged stay of the metal in a similar atmosphere, either cold or at any desired temperature, the latter being controllable at all times by a regulator. I desire to draw particular attention to this point, in view of the difficulty of welding certain metals, notably aluminium and certain kinds of steel.

Voltage.

In principle, the electric pressure to be employed is arbitrary; in practice it depends on the object in view, on the nature of the electrolyte and especially its electrical conductivity; on the kind of electricity available and the dimensions of the parts being dealt with. The pressure employed is always betwen 200 and 500 volts, this being a great advantage over the relatively low pressure required when using an arc.

Some useful practical hints may here be given. The conductivity of liquids increases, generally speaking, with the quantity of the salt or acid in solution, but only up to a certain maximum. For ordinary jobs, although necessitating pressure up to 500 volts, it is better to use weak solutions. A little more care will be necessary as regards insulation, but the cables will be reduced in size and their attachment rendered more simple. In the case of jobs that have to be carried out by hand, a lower pressure, such as 220 volts, with stronger solutions, may be preferred.

Salts other than the alkalis, such as those of iron, manganese, chromium and nickel, require a higher temperature, while similar salts mixed with a suitable acid, or with alkaline salts, can be used with a low or medium pressure according to the degree of concentration of the liquid.

It should also be borne in mind that in making a solution of a certain weight of several salts, the resulting conductivity is greater than the average of the conductivities of individual solutions, each containing the same total weight of one of the salts. To give an example, a solution containing 1 lb. of potassium carbonate, 1 lb. of sodium carbonate, and 1 lb. of ammonium carbonate has greater conductivity than the average conductivities of three solutions, each containing 3 lb. of any one of these salts.

Therefore, to secure a solution of minimum strength to obtain a predetermined conductivity and to work with a given voltage, it is advisable to use a solution of a mixture of salts.

(To be continued.)

The Physical Behaviour of Lead Sheaths in Relation to Failures of High-Voltage Cables.

The author suggests that the alleged creation of voids in normal cables as a result of permanent distension of lead sheaths is a view which distinctly lacks foundation.

By C. J. BEAVER, M.I.E.E.

(Concluded from page 145.)

Having experimentally determined the order of the internal pressures which may be set up by working temperature conditions, and shown the values thereof which may produce permanent distension of the lead sheath in typical high-voltage cables, the general case may now be considered from the mechanical aspect.

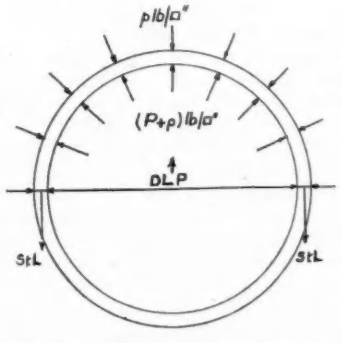


Fig. 6.—Circumferential Stress in Cylinder.

The difficulties of mathematical treatment of the case, due to the indefinite relationship of the various factors, have already been pointed out, and from a general survey it would appear that the longitudinal resultant of the forces due to thermal expansion and solid dilatation is, under average conditions of laying, &c., less important than the diametral component, and probably does not approach the value relative to the circumferential stress (one half) which it would in a plain cylinder subject to an internal pressure.

The question whether the longitudinal stress should be considered to function according to the maximum shear stress breakdown theory, *i.e.*, tending to deform and weaken the lead sheath, or according to the maximum strain theory which infers the opposite effect, would not therefore appear to arise. Under the circumstances it would appear sufficient to consider only the circumferential stress. The ordinary method of computing circumferential stress in a cylinder is illustrated by the diagram, fig 6, where—

D = diameter of cylinder in inches.
t = thickness of cylinder wall in inches.
L = length of cylinder in inches.
P = excess internal pressure in lb./sq. inch.
S = circumferential stress in lb./sq. inch.
p = external pressure.

$$2\,St_L = D.L.P.$$

Circumferential stress $S = D/2t \cdot P$ lb./sq. inch.

Applying this formula to cables A and B, we get $S = 9.2\ (43-15) = 257.6$ lb. per sq. in., and $S = 9.3\ (44-15) = 269.7$ lb. per sq. in., respectively, as the approximate circumferential stress limits of elastic behaviour.

A check on these indications may be directly obtained from the apparatus in another way, *viz.*, by heating the

cable to a temperature producing a pressure which is predetermined in terms of circumferential stress, and taking readings of the oil level in the gauge glass before and after releasing the internal pressure in the cable. This affords a measurement of the elastic volumetric strain in the lead sheath. Clearly, if a high circumferential stress, such as 260 lb. per sq. in., corresponds

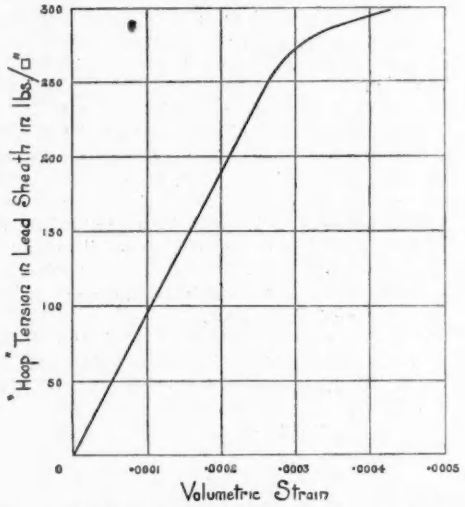


Fig. 7.—Stress-strain Diagram of Lead Sheath.

with an elastic strain, all lower values will lie on a line connecting the point thus plotted with the source. In fig. 7 the calculated "hoop" tension in the lead sheath is plotted against the measured volumetric strain, and the confirmation of results on cables A and B thereby obtained is reasonably complete.

In turn, the approximate elastic limit value arrived at on the lines of these experiments, and as indicated in fig. 7, compares reasonably well with Wertheim's figure for annealed lead of 280 lb. per sq. in.[17]

On the basis of the volumetric strain determined in the foregoing experiment, the modulus of elasticity E of the lead may be evaluated from the formula:—

$$E = \frac{pr}{te}\left(\frac{5}{2} - \frac{2}{m}\right),$$

where E = modulus of elasticity in lb./sq. in.,
p = internal pressure in lb./sq. in.,
r = radius of sheath in in.,
t = thickness of sheath in in.,
e = volumetric strain, and
m = Poisson's ratio (roughly 4).

According to the values pertaining to the above mentioned case, E = 1,900,000 lb./sq. in. as against Wertheim's value of 2,500,000 lb./sq. in. The definite character of the behaviour of the lead sheaths within and around the elastic limit demonstrated in the foregoing should influence the crystallisation of ideas on the actual behaviour of lead under conditions of stress and temperature, and help to destroy the impression which seems to exist that lead is practically plastic and will therefore strain without limit under an attempt to stress it.

The tests described by Emanueli in his paper on "The 132-kV Cable Lines in New York and Chicago,"[18] were prefaced by the following note: "Lead has more the characteristics of a liquid of extremely high viscosity than of a metal, and is deformed under the slightest stress." The author then showed elongation curves of commercial lead, plotted against time in days, at different temperatures, but under a condition of stress considerably exceeding the elastic limit of lead, *viz.*, at 425 lb./sq. in. It is true that in the system the author was describing, the hydrostatic pressure (105 ft. of oil) would probably cause the elastic limit of an ordinary lead sheath to be exceeded, but the experimental results which are the subject of the present article show that there is no justification for statements which infer complete plasticity and ignore the elastic limit of lead.

Again, in Dunsheath and Tunstall's paper on "The Physical Properties of Lead Cable Sheaths,"[19] the authors give the results of a tensile test applied quickly (2,400 lb./sq. in., and 45 per cent. elongation) and after saying "If now, instead of applying a load which will break the strip in a few seconds, we select some lesser load, we find that fracture can be obtained by leaving the sample under test for a long time," they proceed to cite an experiment in which the test piece failed after 230 hours' continuous loading. The tensile stress in this case, however, was about 1,100 lb./sq. in., and no mention is made of the important "failing case" represented by the maximum working stresses which occur in cable sheaths, *i.e.*, stresses below the elastic limit of lead.

The point of the whole matter is that while lead may be properly regarded as having a negligibly low elastic limit for all ordinary mechanical purposes, it is, as shown by the foregoing experimental results, sufficiently high for the worst conditions of normal cable work. Incidentally, it will be obvious from a general survey that where the insulated conductors of a three-phase high-voltage cables are single cables, or separately sheathed three-core cables, the stress values in the lead sheaths will be still further remote from the elastic limit.[20]

Reviewing the conclusions to be drawn from the foregoing, the points which appear to be proved, indicated, or suggested may be summarised as follows:—

(*a*) That under normal working conditions of load in high-voltage cables, the internal pressures produced are insufficient to produce permanent distension of the lead sheath.

(*b*) As the matter is simply one of maximum internal pressure *versus* elastic limit of the sheath, a greater margin (though practically unnecessary) can easily be provided if desired by either employing an increased thickness of lead or substituting for it one or other of the hard lead alloys which are commonly used for cable sheathing purposes; the necessity for external reinforcement does not arise.

(*c*) As regards amplitude of the pressure variation over the temperature range, the prior impregnated solid-compound type of dielectric has the greater margin of safety, because of the physical properties of its dielectric components, albeit its residual compressibility is probably less. As regards range of pressure relative to atmospheric pressure, values are initially of a lower order in the ordinary vacuum (*en masse*) impregnated type, because of subsequent contraction after being sheathed warm, thus tending to counteract the effect of greater amplitude due to larger coefficients of expansion of the dielectric materials.

In both types of cable, therefore, inherent conditions exist which have a restricting rather than an exaggerating influence on the relation referred to under (*b*).

(*d*) As many failures of high voltage cable have occurred where the conductor temperature has not exceeded 140 deg. F., and therefore the elastic limit of the lead sheath has not been approached, it would appear that the alleged creation of voids by permanent expansion of the lead sheath could not in such cases have been a contributary cause.

It follows that the voids (which presumably have been observed in post mortem examinations of cable failures) can only have been due to the aggregation of originally occluded or entrained air or gas, possibly inflated to a slight extent in the breakdown area by gas formed as a result of dissociation under ultimate stress.

Finally, the overriding conclusion which can hardly be avoided is that the general widespread idea regarding the alleged creation of voids in normal cables as a result of permanent distension of lead sheaths is one which distinctly lacks foundation.

[17] "A Handbook of Testing Materials." C. A. M. Smith, M.Sc. Constable, London.
[18] *Ibid.*
[19] *Journal* I.E.E., Vol. 66, No. 375, p. 283.
[20] The cables referred to in Höchstädter and Barrat's R.G.E. article (*loc. cit.*) were single conductor cables.

Unemployment in 1928.

A review of the state of British Industry during the year, with particular reference to the Electrical Trades.

AN investigation of conditions in the various branches of British industrial activity shows that the electrical trades occupy a very favourable position in comparison with most other industries, and this is clearly illustrated in the accompanying curves which show the course of unemployment during the past two years.

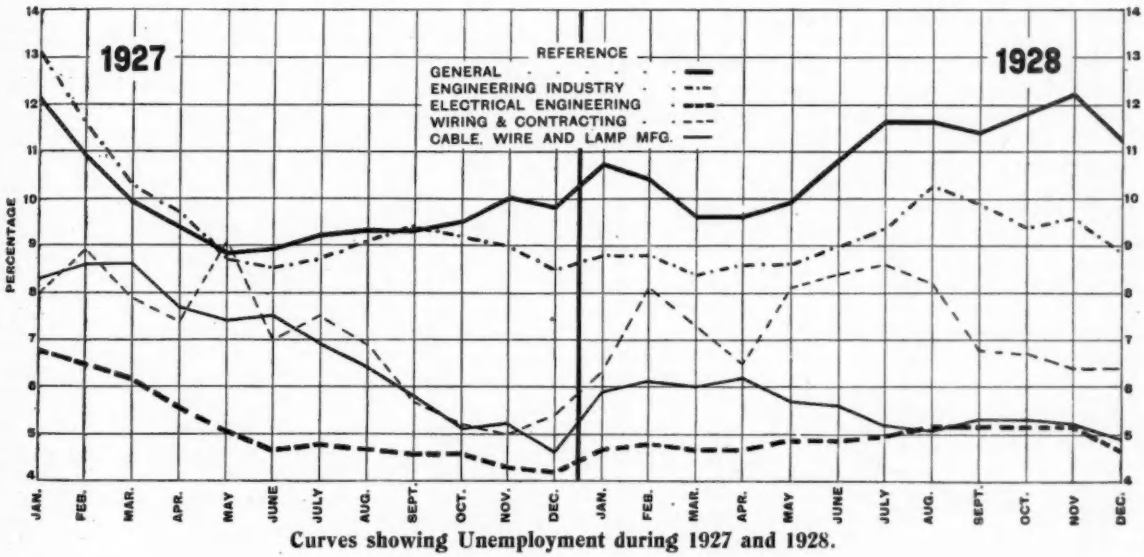
In industry generally, the conditions durng 1928 were unsatisfactory, and towards the end of the year the unemployment figure had risen above the high level which marked the commencement of 1927. At this time industry was still in process of recovery from the effects of the general strike, but during 1928 there were no industrial disputes of any magnitude. The monthly average rose from 9.8 in 1927 to 10.9 per cent. in 1928. Of course the coal mining industry was mainly responsible for the gloomy situation. At December 17th last this industry had 213,024 registered unemployed, the proportion of the total being 19.1 per cent. Several industries showed higher percentages of unemployment, although their actual numbers were not so great; they included shipbuilding and ship repairing (30.3 per cent.); public works contracting (24.3 per cent.); the manufacture of brass, copper, tin, zinc, lead, &c. (19.8 per cent.); and iron and steel manufacture (19.8 per cent.).

The curve for the engineering industry (including electrical engineering) shows that there was an improvement on the whole during 1928. The monthly average of unemployment was 9.1 per cent., as compared with 9.7 per cent. in 1927. The general tendency was, however, for the figure to rise, although in December there was a decided improvement. The marine engineering section, with an unemployment percentage of 15.3 at December 17th, was the most depressed, while electrical engineering (4.7 per cent.) was by far the most satisfactorily placed.

The latter industry, as will be observed from its unemployment curve, enjoyed a remarkable measure of stability during last year, although unemployment was comparatively high during the latter half. The monthly average for 1928 was 4.9 per cent.; in 1927 it was 5.2 per cent. The last point on the curve (December) is 4.7 per cent. In the detailed analysis of unemployment in the last *Ministry of Labour Gazette* only 12 industries out of a hundred were credited with a lower percentage of unemployment; these included the printing and paper trades, tobacco manufacture, &c.

The Ministry of Labour, no doubt for good and sufficient reasons, lumps together the electrical cable, wire and lamp manufacturing industries for the purpose of unemployment statistics. The curve illustrating the course of unemployment in this group shows that a considerable improvement took place during 1928, although actually the percentage of unemployed was higher at the end of 1928 than at the close of the preceding year. The monthly average fell from 6.8 per cent. to 5.5 per cent.

The fifth and last curve is that dealing with the electrical wiring and contracting industry. The seasonal nature of the business makes it hard to draw definite conclusions, especially when the seasonal activities do not occur in corresponding months of successive years. It looks, however, as if a great deal of work is deferred until the end of the year, the lowest parts of the curve falling in the last quarter in each year. On the whole, the position of the industry was not so good last year as in 1927; the monthly average of unemployment rose from 7.0 to 7.3 per cent.



Curves showing Unemployment during 1927 and 1928.

It may be useful to set forth some actual figures (as against percentages) to convey an idea of the numbers employed and unemployed in the industries mentioned. The last available statistics are dated December 17th last. Then the estimated number of insured persons in industry was 11,881,500, including 3,259,600 females. The total number of registered unemployed was 1,333,611, including 78,413 casuals. The engineering industry had 979,050 insured employés, including 88,860 females, and 87,511 unemployed. It included 79,770 insured workers (17,190 females) in electrical engineering, of whom 3,732 were unemployed. The number of insured persons in the electrical cable, wire and lamp manufacturing group was 86,180 (including 32,190 females), and of these 4,202 were unemployed. The electrical wiring and contracting industry covered 15,530 insured persons (1,290 females), and showed 991 as unemployed.

Domestic Progress and Prospects.

An optimistic forecast, based on sound data, indicating abundant work for the electrical manufacturing and electricity supply industries.

By D. J. BOLTON, Author of "Electrical Engineering Economics."

IT is generally agreed that the statistics of electricity supply form a very useful barometer of the conditions and the prospects of electrical trade generally. This is true to-day, although there are a few pessimists to be found standing round a barometer which is steadily and rapidly rising, shaking their heads and prophesying bad weather. Electrical energy is a little like Shakespeare's description of mercy, "It blesseth him that gives and him that takes." A rise in the quantity of energy consumed each year means at the one end additional business in generation, transmission and distribution gear, and at the other end additional sales of motors, instruments, lamps, and cookers. Electrical energy not only necessitates elaborate and expensive machinery to produce it, it also utilises a very wide range and complexity of apparatus in its consumption. In this respect electricity differs notably from gas, in which the consuming apparatus is a relatively minor item.

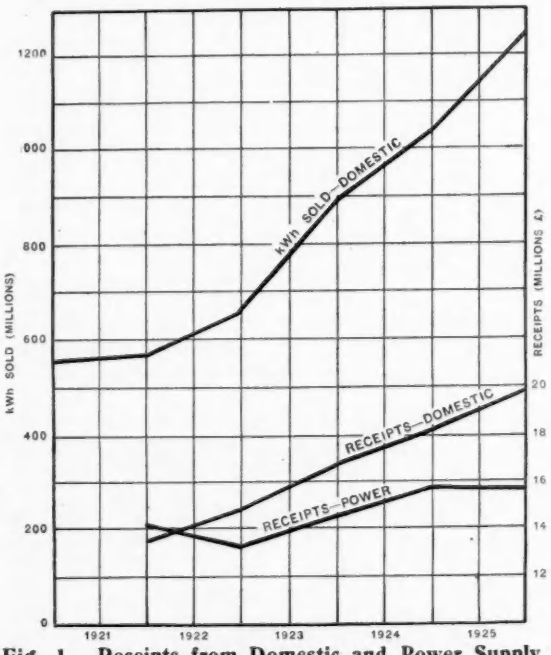


Fig. 1.—Receipts from Domestic and Power Supply, 1920-26.

As an example of the conclusions which can be drawn from the readings of the electrical supply "barometer," the following calculation is of interest:—The annual increase in the power load during the last few years of which figures are available has been of the order of 400 million units. Neglect for the moment the additional plant necessary to generate and transmit this energy and consider only the additional apparatus necessary to consume it. It will be clear that a steady and continuous rise of this kind cannot be due to a fuller use of existing apparatus such as might account for temporary fluctuations: it can only be due to the installation of new gear. Suppose, as a basis of calculation, that the new gear takes the form of induction motors which are in use on the average for the equivalent of four hours' full load per day and 300 days a year. Suppose also that they have a working efficiency of 80 per cent. The added power load referred to would then involve the installation of 360,000 horse-power of new plant each year. Of course, the new load would not all go in induction motors, but it will all go into some sort of electrical gear. Moreover, the above refers only to the *additional* power load for the year. Even had there been no added load, there would obviously be sales of motors for renewals, replacements, and changes of various kinds.

If the above argument is sound as regards electricity supply as a whole, it is particularly true of the domestic consumption, for two reasons. In the first place, the domestic portion is increasing at a greater rate than any other part of the load. In the second place, the consuming apparatus is in general much more short-lived, so that a given number of kWh in lighting and domestic consumption will usually represent a much more frequent turnover of apparatus than the same magnitude of power load. One has only to compare an induction motor with a life of twenty years or, say, 50,000 hours of use with a lamp having a life of only 1,000 burning hours, to see that a given number of kWh will represent a great many more replacements in the latter case than in the former.*

There are those who sneer at the lighting load in this country as the baby of electricity supply—accounting for only one-fifth of the total from public supplies and a still smaller proportion if the private supplies are taken into account. But it is a sturdy infant and growing fast, so much so that other authorities profess to be afraid of it and wish to see it grow no larger. But whether regarded as a promising youngster or an *enfant terrible*, there is no mistaking its increasing magnitude and importance. If instead of comparing kWh sold one compares the revenue received, it will be seen that, in spite of decreasing prices, the income is steadily growing, and since 1921 the domestic receipts have actually been greater than the receipts for the power load. Fig. 1 shows the receipts from the two main groups of consumers—the domestic and the power group during the years 1920-6. These figures are for the whole of the public supply authorities in Great Britain, and on the same base is shown the number of units sold for lighting and domestic purposes. There is no mistaking either the rapid growth in the domestic consumption or the increasing importance of the revenue derived therefrom.

In dealing with the domestic consumption of electricity, it is natural to compare it with that other form of household supply—gas. Frequently the gas and electrical industries are keen competitors: at best they are friendly rivals meeting similar needs and frequently under the same management. It therefore cannot fail to be of interest to see how the two industries have fared in the same period. Statistics of the gas industry as a whole have not been carried to quite the pitch of perfction that is reached by our own Electricity Commissioners, but in the case of the municipally-owned enterprises plenty of figures are available.

In order to get similar magnitudes, as well as similar managements, the plan has been followed of taking the six largest municipalities owning both gas and electricity undertakings.† In the bottom curve, fig. 2, are plotted the total receipts for the six towns from gas

* According to one estimate made by the writer, an induction motor on an average may be expected to consume something like 100 times its purchase price in energy in the course of its life, whereas a lamp will only consume from 5 to 10 times its purchase price. ("Electrical Engineering Economics.")

† Manchester, Birmingham, Glasgow, Leeds, Edinburgh, Bradford.

supply in the six years ended March, 1927. On the same base are shown the kWh sold for lighting and domestic purposes in the same towns and the receipts therefrom. (In the case of the last year the figures are estimated from the *total* sales, assuming the same proportions as in the previous year. This portion of the curve is therefore dotted.) It will be seen that, whilst gas receipts have shown no general tendency, domestic electricity receipts have risen steadily. Moreover, gas

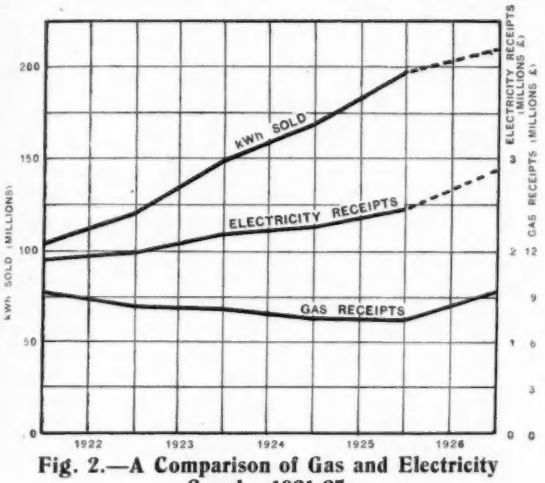


Fig. 2.—A Comparison of Gas and Electricity Supply, 1921-27.

prices, although difficult to compare owing to the change-over in the basis of charge, have not shown any general and considerable drop during the period, so that the curve of quantities sold would not differ very greatly from the curve shown for receipts. But in the case of electricity the prices have fallen so considerably and consistently that when units sold are plotted, the curve shows much more striking progress.

So much for the past: now for the future. In attempting to forecast future developments in this sphere, it must not be forgotten that the increase in the domestic load is a two-dimensional one—an increase in the number of consumers and an increase in each individual's consumption. In the first place, only one house in four or five now uses electric light, and this number is destined to be enormously increased since no one really prefers any other form of illumination. But the load will also increase in the second dimension as these same lighting consumers learn to put electricity to other uses. Many prophecies have been made and many confounded either by being exceeded or by remaining unfulfilled; and the present writer has no intention of adding to their number. For the purpose of this article it will be sufficient to take the estimate made by Colonel Edgcumbe in his I.E.E. presidential address last October, based on a careful survey of all the available figures.

This estimate is illustrated in the diagram, fig. 3. The ordinates on the left represent the total consumption in 1924 from both public and private sources, this being obtained from the Commissioners' figures and the returns from the Census of Production. The total is divided up amongst the different groups of consumers in the manner shown. The ordinates on the right represent the anticipated total for 1940, and this is also divided up into the proportions which it is estimated that the different types of load will then reach. In order to show clearly the expansion which would be involved in such a growth, a column has been drawn on the right of the curve made up of rectangles whose height represents the anticipated consumptions. The lower part of each rectangle is unshaded and represents the 1924 consumption, whilst the upper shaded portion represents the expansion which would result from the new figure.

It will be seen that whilst the total consumption is expected to be doubled, the domestic consumption is to be something like seven times the 1924 figure. (At first sight this may be thought a somewhat extravagant prophecy, but it must not be forgotten that the annual increase during the last few years has been at the rate of some 20 per cent. of the previous year's total. If the same *proportional* increase were maintained, the total in 1940 would be not seven times, but 18½ times the 1924 figure!) It will be interesting to glance for a moment at the implications of such an increase, which may conveniently be considered under two heads—annual consumption and annual growth. Considering the first point, an annual consumption for lighting and domestic purposes of some 8,000 million kWh in 1940 would necessarily involve an enormous sale of consuming apparatus. Even if only a quarter of this were for lighting purposes, then, taking as an average the 40-watt lamp with a life of 1,000 burning hours, this consumption would involve an annual sale of 50 million lamps. The other three-quarters would also be consumed in apparatus of some kind, all of it requiring periodic renewal and replacement.

Consider next the annual growth of load. With a constant utilisation factor, this means a corresponding increase in the apparatus installed. The mean annual increase in the lighting and domestic load involved in the above estimate is about 400 million units. It may be taken that the maximum demand will be about 30 per cent. of the total connected load, and the load factor between 30 and 40 per cent., giving a net utilisation factor of, say, 10 per cent. With this assumption this would mean the purchase and installation of half a million kilowatts of new apparatus each year merely to account for the *increase* in consumption, and without any allowance for depreciation, replacement, and renewals of the gear responsible for the initial value of the consumption.

In conclusion, there is no need to stress the purely supply side of the question. It will be clear enough that

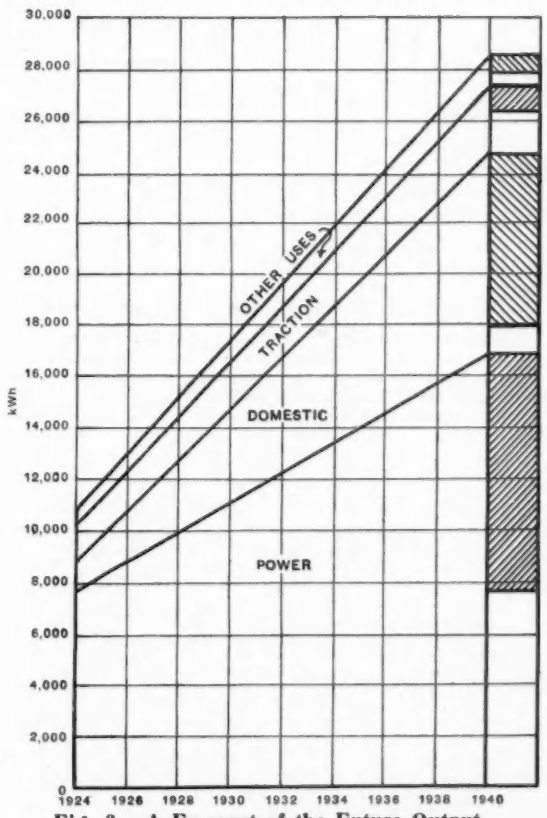


Fig. 3.—A Forecast of the Future Output.

if the total load, and in particular the domestic portion of it, is to grow to anything like the dimensions indicated, there will have to be enormous developments of the generation, transmission, and distribution equipment necessary to supply it. Even if a much more conservative estimate is made of future progress, there would still appear to be abundant grounds for a very considerable optimism.

Legal.

Lektophone Corporation v. S. G. Brown, Ltd.

JUDGMENT in this action was delivered by Mr. Justice Tomlin in the Chancery Division on January 23rd. The action was heard in December (*vide* ELEC. REV., December 14th, 21st and 28th), and the plaintiffs claimed an injunction restraining infringement of a patent granted to Marcus Clarence Hopkins for improvements in sound regenerating machines. The infringement was alleged to be found in a " Mascot " cone loud-speaker made to the designs of Mr. S. G. Brown, and sold at the Radio Exhibition, 1927.

The defendants denied infringement, asserted that the patent was invalid because of prior user, common general knowledge and insufficiency, and they counter-claimed to have the patent revoked.

His LORDSHIP said the patent was one of a number relating to sound regenerators owned by the plaintiffs, who had granted licences to manufacture under it since 1926. At the date of the patent—1913—sound regenerators had but a limited field, the only instruments calling for them being the gramophone, phonograph, and loud-speaking telephone; broadcasting was unknown. Therefore in 1913 the problem for constructors of sound regenerating machines was how to combine in their diaphragms rigidity with an inertia not too great for the limited power then available.

The first application in England for a patent for Hopkins's invention was made in July, 1914. In his specification Hopkins confined himself to the art affecting instruments which produced vibration by the movement of a stylus over a record. He thought Dr. Eccles was right in saying in his evidence that Hopkins did not appreciate that he could get lower frequencies with a larger diaphragm. As to what Hopkins claimed in his specification, his Lordship said he was satisfied that the claims were for a stylus or record machine with a diaphragm reproducer operating without a sound-box, horn or trumpet, but with a tympanum at least nine inches in diameter, having conical and annular portions, the latter being supported by rings at its outer edge.

This view, said his LORDSHIP, would be sufficient to dispose of the action, as the alleged infringing article was a loud-speaker in the modern sense for broadcasting, and was not built for use on a record or stylus machine. It was impossible for the inventor to claim novelty for a mere increase in the size of the diaphragm, mere rigidity, or mere coning of the diaphragm to secure rigidity. What was novel appeared to rest on a combination of the following: Taking a large diameter, giving it lightness, rigidity and support, and abolishing the sound-box, earpiece, or horn, and by this means producing the radiation of sound waves directly into the air. After examining the prior specifications and documents relied on by the defence he was satisfied that this element of novelty had not been anticipated, and that the patent was not bad for lack of novelty, lack of subject-matter, or insufficiency.

His LORDSHIP said he had seen a number of the loud-speakers manufactured by the plaintiffs' licensees. Many of them seemed to have little resemblance to Hopkins's diaphragm, and he expressed no opinion as to whether any or which of them was constructed according to the plaintiffs' specification. On the true construction of that specification he held that the " Mascot " loud-speaker did not infringe the patent. The result was that both the action and the counter-claim failed, and must be dismissed. On the question of costs, he gave the defendants four-fifths of theirs, and the plaintiffs one-fifth of theirs, and dismissed the counter-claim with costs.

County Electrical and Wireless Stores, Ltd.

A COMPULSORY winding up order in respect of this Company was made by Mr. Justice Romer on January 28th.

City of London Electric Lighting Co., Ltd.

IN the Chancery Division on Monday last, Mr. Justice Romer approved an alteration of the company's memorandum of association, to enable it to guarantee an issue of debenture stock by its subsidiary, the Bankside Investment Trust. Mr. BUCKMASTER, for the company, said that the Trust was formed to acquire properties suitable for sub-stations, &c., and to let out such parts as were not required for this purpose. The Trust proposed to issue £1,000,000 of debenture stock (£700,000 immediately), and it could raise the money on better terms if it had the guarantee of the parent company.

Alleged Fraudulent Use of Electricity.

AT the Birkenhead Police Court on January 25th, Harding Miller, a wireless dealer, was summoned for using electricity through a power meter for lighting purposes. Mr. A. C. SHEPHERD, for the Corporation, alleged that defendant had so fitted wires that the energy from his power meter was used for lighting purposes. The charge for lighting was 4½d. per kWh and for power 2d. Evidence was given by inspectors of the Electricity Department that the lighting circuit was switched off and that two lights were burning, being supplied through the power meter.

Defendant pleaded that the light in the workroom was a pilot lamp used to indicate that the charging power was in service. It was there in accordance with factory regulations. The light called attention to the fact that charging was going on and to guard against employés receiving shocks.

The magistrates expressed the opinion that in the future there might be some regulation requiring " pilot " lights to be placed on the switchboard and not used separately. They dismissed the summons.

Standard Telephones & Cables Patents.

MR. JUSTICE TOMLIN, in the Chancery Division on January 28th, heard an application by Standard Telephones & Cables, Ltd., for the extension of the period of seven patents relating to improvements in connection with machinery and apparatus used in automatic telephony. The application was based on the loss or damage which the company said it had suffered by reason of the war.

Mr. TREVOR WATSON, for the company, said the patents belonged to the Western Electric Co., Ltd., and Standard Telephones & Cables, Ltd., was simply a change of name. There was no opposition. He read an affidavit by the chairman of the company, which stated that soon after the war broke out the company became a controlled establishment, and the practical use of the patents was postponed for six years because of that fact and also because of the delay in the reorganisation of the telephone service of this country. The company's system was a rotary system, the feature of it being that it was applicable to systems manufactured by other companies. All the companies engaged in this work had pooled their patents for the use of the General Post Office.

His Lordship made an order extending the period of all the patents until February 11th, 1934.

Relay Automatic Telephone Patents.

IN the Chancery Division on January 28th, Mr. Justice Tomlin granted an extension of the period of a number of patents for improvements relating to automatic or semi-automatic telephone exchange systems, for three years from April 23rd next, on the application of the owners, the Relay Automatic Telephone Co., Ltd.

Mr. TREVOR WATSON, for the company, said it was not one of the companies that succeeded in getting its system adopted by the General Post Office, but there would have been a better chance of that if it had not been for the war. The company was a late-comer into the field of automatic telephony, and at the time of its entry into the English market its system was not wholly adapted to the requirements. Every step, therefore, had to be carefully considered. The main reason for the application, however, was loss or damage in the use of the patents occasioned by the war.

Cherry v. London Electric Railway Co.

MR. JUSTICE EVE, in the Chancery Division on January 25th, dismissed a motion by Mr. H. Cherry, costumier, 180, High Street, Camden Town, N., for an interim injunction to restrain the London Electric Railway Co. and its contractors from continuing the construction of an escalator at High Street Station, Camden Town, so as to cause a nuisance by noise and vibration at night.

At the conclusion of the arguments Mr. JUSTICE EVE, in giving judgment, said that he was not satisfied on the evidence that a real nuisance existed; the plaintiff had systematically prevented the defendants from testing the matter in his own house. He did not think it was a case for an interlocutory order. He thought the defendants' statutory powers were being exercised reasonably.

Philips's Enterprise in Germany.

The Philips Glow Lamp Company, aiming at an expansion of its interests in Germany, is reported to have acquired a large interest in the Berlin Lorenz Company, and thus the radio apparatus made by the Dutch company, which has hitherto been exported to Germany, will now be manufactured by the Lorenz company, so that the former will avoid the high German import duties and other charges. In the case of radio valves, the Dutch company is said to have acquired the majority of the shares in the Müller valve works at Hamburg, which affords the possibility of opening up the German market to the Dutch firm. It is hinted that the Philips company will make use of the Lorenz patents for the purpose of a large expansion in the German market and thus compete with the Telefunken Company, without violating the agreement with the latter. It is further suggested that the Dutch company may attempt to embark upon the telephone business, which would be possible through the Lorenz company, which is one of the largest makers of telephone apparatus in Germany.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments. Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

Amalgamation of Well-known Electric Motor and Plant Companies.

That the appreciation of "rationalisation" is becoming more and more apparent is exemplified by the amalgamation of two of the oldest established electrical engineering firms which, we understand, is now in process of completion, *viz.*, that between Laurence, Scott & Co., Ltd., Norwich, and Electromotors, Ltd., Openshaw, Manchester, under the new title—subject to the approval of the Board of Trade—of Laurence, Scott and Electromotors, Ltd.

Messrs. Laurence, Scott & Co., Ltd.—one of the oldest firms in the industry, established in 1883—have a wide range of manufactures, embracing large generating units with the corresponding range of motors which enables them to electrify the heavier trades. For many years they have specialised in the electrical equipment of ships of every class. They rank amongst the chief suppliers to the British Admiralty, and foreign admiralties, of generating and motive power equipment. They have established a world-wide reputation for their electric deck winches, windlasses, capstans, and the electrical equipment of dockside cargo-handling plant.

Electromotors, Ltd., were established in 1899, and possess one of the finest plants in the country for the manufacture of a specialised range of d.c. and a.c. machines up to 150 horsepower, thus covering the general demand for industrial purposes. Like their future associates they also have a specialised range of motors for driving ships' auxiliaries.

Both firms have built up and maintained a substantial reputation at home and abroad for reliability and good service among the users of electrical machinery. The very low price levels for electrical machinery which set in after the slump of 1921 have been a source of temptation to reduce the quality of materials and workmanship, which both Messrs. Laurence, Scott & Co., Ltd., and Messrs. Electromotors, Ltd., have resisted, and their reputation after this severe testing-time is now as high as ever.

The fundamental idea of this L.S.E. amalgamation is naturally the elimination of redundant output, the concentration in each works of the class of machinery for which it is best adapted, the combination of buying and selling, as well as of technical skill in the advancement of methods of manufacture, and the solution of many problems which in these days of progress confront the electrical engineer, thus in all essentials leading to the reduction of costs, the increase of output and, incidentally, of the number of men employed.

The L.S.E. combination of two such well-known concerns of entirely British capital (for by its constitution foreigners are barred from its register of shareholders) is of peculiar interest to the electrical industry. There is a strong board of directors, including Mr. C. Wilson (chairman), Mr. W. H. Scott (founder), Captain G. J. Scott, and Mr. G. H. Wilson, all of Laurence, Scott & Co., Ltd., with Sir Benjamin Longbottom and Mr. Ernest Greenhalgh, of Electromotors, Ltd. These gentlemen have a life-long connection with their respective firms and are well-known in the industry. It starts its public life with the advantage of having no "charges" of any sort on its capital, the whole of this being in ordinary shares, and as each business has been largely built up by conserving and absorbing its profits, it will be seen that with a total capital of £311,000 and a turnover on last year's business of over half-a-million, it should have great potentialities. The shares are strongly held, and it is not anticipated that many will come into the market, although we understand that a Stock Exchange quotation will be applied for.

The Financing of Industry.

In the course of his speech at the annual meeting of the Midland Bank last week, Mr. R. McKenna (chairman) analysed the advances made by the bank outstanding on June 30th last. By this he showed that the industry which had borrowed the most (12¼ per cent.) was the textile group. Building and land represented 11¼ per cent., and wholesalers and retailers were responsible for a similar amount. The next largest group included the heavy industries—iron and steel and other metal manufacturers, engineers, machinists, shipbuilders, &c. These took 7¾ per cent. of the loans. Conditions in the different branches varied widely; some sections showed marked prosperity, while others were in a state of extreme depression. It was therefore satisfactory for them to find that the loans were widely spread over this field. After dealing with a number of other groups, the speaker came to local authorities and gas, electricity, water and other public utility companies, which together took 3¼ per cent.

In closing his address, Mr. McKenna said: Ten years have passed since the conclusion of the most recent, and we devoutedly hope the last, great war in the world's history. They have constituted a decade of grave difficulties, involving problems of exceptional magnitude and complexity. Disappointments have been frequent; many setbacks have been suffered. But I do not think it will be denied that considerable progress has been made towards a more ordered and prosperous world. At home much has been achieved in improving the relations between employers and employed, and the need for industrial reorganisation has become more widely recognised and accepted. It may be said with truth that the prospects of peace, both international and industrial, have brightened. Peace between nations and within nations is a primary condition of our welfare, and whatever the temporary state of trade, however slow we are in solving the financial and industrial problems which confront us, we still look forward with unshaken confidence to the time when the better relationships now established shall become the foundation of general and permanent well-being.

Central Electricity Board Contracts.

We briefly reported in our last issue that the Central Electricity Board had placed contracts for the transformers for the South-East England Scheme with Messrs. Ferranti, Ltd., and the Fuller Electrical & Manufacturing Co. Messrs. FERRANTI now inform us that their contract is for 60,000-kVA, 30,000-kVA, and 20,000-kVA, 132-kV, 3-phase units, of a total capacity of 1,100,000 kVA. Working in close co-operation with the railway companies concerned, the designers have succeeded in making the largest of the 60,000-kVA units suitable for transport in oil by rail under normal traffic working conditions. The manufacturing facilities at the Hollinwood and Stalybridge factories are such as to enable the company to build these transformers with on-load tap-changing mechanism entirely from the raw material.

In our advertisement pages to-day the Central Electricity Board invites tenders for the following:—South-East England Electricity Scheme.—66,000-V and other transformers (London area).

Recent Contracts.

Contracts for vacuum and gasfilled lamps have recently been placed by the Admiralty with the GENERAL ELECTRIC CO., LTD., SIEMENS ELECTRIC LAMPS & SUPPLIES, LTD., and METRO-VICK SUPPLIES, LTD.

Among the orders recently received by the D.P. BATTERY CO., LTD., are the following: A battery of 115 cells (1,950-Ah capacity) for the B.B.C.'s first "regional" station at Brookmans Park, Potters Bar; and (through Messrs. Wingrove and Rogers, Ltd., and Greenwood & Batley, Ltd.) a total of 52 "Kathanode" batteries for the electric locomotives which are being used in connection with the Mersey Tunnel excavations.

STANDARD TELEPHONES & CABLES, LTD., has received an order from the General Post Office for a main automatic telephone exchange at Newcastle, together with eleven satellite exchanges, representing an immediate total of 20,000 lines, with provision for extension to 42,000. The contract will be completed towards the end of next year.

The Chilean Naval Commission has had British-made cables installed in all its six new torpedo boat destroyers built by Messrs. Thornycroft & Co., Ltd. The installation involves nearly 60 miles of v.i.r. cable and nearly a mile of paper-insulated lead sheathed ring main cable, all of which has been made by the PIRELLI-GENERAL CABLE WORKS, LTD. (one of the associated companies of the General Electric Co., Ltd.).

Unemployment.

The number of registered unemployed declined by 17,600 during the week ended January 14th. The total at that date was 1,435,000, as compared with 1,452,620 on January 7th, and with 1,193,810 on January 16th, 1928.

New Showrooms at Watford.

On January 22nd Messrs. J. W. RUSSELL, LTD., electrical engineers and contractors, opened new showrooms in Queen's Road, Watford. The attractive nature of the new premises is brought out by the exterior view, which we produce herewith. The frontage of the premises is 34 ft., the showrooms having a depth of 80 ft. The windows are laid out on the "island" system, and have a total frontage of 84 ft. The ceiling lay-out is on the panel principle, having a flush plug and fitting hook fixed at each panel crossing; each fitting is switched separately, permitting any of the 200 fittings to be demonstrated independently. Different sections of the showrooms are laid out as dining room, drawing room, &c., and at the rear of the main showrooms are rooms fitted out to demonstrate kitchen and bathroom apparatus working under actual conditions. Above the main showrooms are the offices and large stock rooms, as well as a workshop for the repair of all classes of electrical equipment. The opening of the premises was attended by the chairman of the local Electricity Committee, Councillor H. Coates, and the chief engineer of the Electricity Supply Department, Mr. A. W. Barham, as well as representatives of the leading manufacturing firms.

Messrs. Russell's New Showrooms, Watford.

Indian Import Duties.

Some particulars of import and export duties imposed by the Government of India for the current year are given in the *Board of Trade Journal* for January 24th. From this it is seen that electrical control and transmission gear, up to 10 A at 250 V, and certain other apparatus is subject to an import duty of 15 per cent. *ad valorem*. The duty on telegraphic instruments and apparatus for a railway administration is 10 per cent. *ad valorem*. Wires and cables and other parts of a transmission system are admitted free of duty.

Local Exhibition.

WOKING.—The Woking Electric Supply Co., Ltd., is taking a prominent part in the Woking Trades Exhibition to be held from February 6th to February 16th. The General Electric Co., Ltd., is co-operating with the Supply Company in this connection, and has undertaken to equip a five-room electric bungalow, as well as furnishing the Supply Company with a considerable quantity of household appliances for the company's own stand.

Social Events.

The staff of Lighting Trades, Ltd., met at dinner on January 18th, at the Piccadilly Hotel. Mr. H. J. Mitchell, chairman of the company, presided over a gathering of 160, and he was supported by Mrs. Mitchell and other directors of the company. Musical items and the distribution of carnival novelties added to the gaiety. Following the loyal toast, Mr. Mitchell welcomed the staff and the visitors, including Mr. J. R. Yates, the chairman, and several members of the Welsbach Light Co., which was recently acquired by Imperial Chemical Industries, Ltd. Long-service awards, in the form of silver watches and medals, were presented to four members of the staff. After the dinner there was dancing until 12.30 a.m.

The seventh annual dinner and concert of the indoor and outdoor staffs of Messrs. Francis Polden & Co., Ltd., was held on January 19th, at Anderton's Hotel, under the chairmanship of Mr. F. C. Polden, C.C.

The fifth annual works social given by the directors of Heyes & Co., Ltd., Wigan, was held on January 19th. Among those present were Mrs. W. A. Heyes (Mr. W. A. Heyes, the governing director, being absent through illness), Miss Heyes, Messrs. A. V. Heyes (director), J. W. Cartwright (works manager), and J. C. Muir (secretary). The evening commenced with whist, after which the prizes were distributed by Mrs. Heyes. Supper was then served, and dancing, with items of entertainment by Mr. Elsworth, occupied the rest of the evening.

The London office staff of Bakelite, Ltd., held their first dance on January 19th, at the Temple Restaurant, Victoria Embankment.

Venner Time Switches, Ltd., entertained their staff and employés at their annual dinner on January 18th, at Lyons' Piccadilly Corner House. During the evening the bonus award was distributed; owing to last year's good progress the bonus was a record one. Mr. R. C. Graseby, the managing director, in replying to the toast of "The Directors," referred in his remarks to Mr. E. E. Sharp's Australasian tour, and arranged for a cablegram of greeting to be dispatched to him in New Zealand. The function terminated with a musical programme.

On January 19th the staff of Messrs. Ernest F. Moy, Ltd., held their annual dinner at "The Britannia," Camden Town. The chairman of the company, Major C. G. Fox, presided over a company of about a hundred, and he was supported by the managing director, Mr. P. H. Bastie, and a number of guests.

The staff of Messrs. Walker Bros., Birmingham, held their fifth annual whist drive and dance on January 18th at the Priory Rooms, when upwards of 200 employés and friends were present. The arrangements were carried out by the Social Club Committee. Prizes for whist, novelty dances, &c., were distributed by Mrs. G. N. Walker, and the "Swanee" dance band provided the music.

There was a gathering of about 400 at the Town Hall, Dudley, on January 19th, the occasion of the annual dinner of the staff and employés of the Shropshire, Worcestershire and Staffordshire Electric Power Co. Mr. T. E. Boothy, chief generating engineer, presided, and amongst those present were Mr. J. T. H. Legge, chief engineer and manager, and departmental chiefs and district representatives. The visitors included the Mayor of Dudley. The toast of "The Company" was proposed by Mr. S. A. Woodhall, and responded to by Mr. Legge. The Mayor of Dudley also spoke. A concert was given by the "Merry Optimists," and Mr. G. Mountford, an employé of the company.

New Tunbridge Wells Showrooms.

The accompanying illustration is a view of the new showrooms which were recently opened by Messrs. E. Powell, Ltd., Tunbridge Wells. This is the latest development of a concern which commenced electric lighting installation as long ago as 1884, when it had its own generating plant, as well as a portable installation for exhibitions, &c. The new showrooms are situated in the High Street, and are admirably equipped and arranged.

New Showrooms at Tunbridge Wells.

Correction.

In the advertisement of the Sun Electrical Co., Ltd., appearing on page 48 (Supplement) of our issue of January 18th, under the illustration of the "Cosyglo" fire, the loading of that particular price of fire is incorrectly given. The loading should read 2 kW, not 3 kW.

Bankruptcy Proceedings.

J. W. TURTON, Market Place, Banbury, Oxon., electrical engineer.—The public examination herein was held recently at Banbury, when a deficiency of £457 was disclosed. The debtor stated that he commenced trading in August, 1919, with a capital of £20. He entered into a partnership, but that was dissolved in 1923, a sum of £199 being paid to him. With that sum the debtor again commenced trading, but he had been sued by creditors. He had resorted to moneylenders, and had overdrawn at the bank. He attributed his failure partly to ignorance as to the keeping of books. The examination was adjourned.

J. ROYSENTUL, electrical engineer, 45, Woodbury Grove, Finsbury Park, London.—Receiving order made January 17th on a creditor's petition. First meeting held January 30th. Public examination February 26th, at Carey Street, W.C.2.

P. FORD, electrical contractor, Macdonald's Lane, Corporation Street, Manchester.—Trustee, Mr. F. Murgatroyd, Senior Official Receiver, Byrom Street, Manchester, released January 10th.

J. B. WICKSTEAD, R. J. ALLEN and LILIAN KNIGHT, trading as Chas. Cooper & Co., plumbers, electrical engineers, &c., 26, King Street, Stretford.—First and final dividend of 2d. in the £, payable January 28th, at 47, Mosley Street, Manchester.

R. J. ALLEN (separate estate).—First and final dividend of 2s. 6d. in the £, payable 47, Moseley Street, Manchester.

T. F. COLLIER, electrician, 64, Union Street West, Oldham, late of 116, Union Street West, Oldham.—Last day for proofs for dividend February 9th. Trustee, Mr. J. D. Turner, Official Receiver, Byrom Street, Manchester.

F. J. HUDSON, electrical engineer, 44, Heath Road, Bradford.—Receiving order made January 21st, on debtor's own petition.

W. H. DICKSON and A. J. SOLOMON (Dickson & Solomon), electrical and wireless engineers, 13 & 14, Tavistock Street, Devonport. Trustee, Mr. A. N. Goodman, 11, St. Aubyn Street, Devonport, released January 16th.

W. HEANEY, electrician, 12, Market Place, Henley-on-Thames. Trustee, Mr. T. Gourlay, 29, Russell Square, W.C., released January 18th.

Company Liquidations.

HASLAM FOUNDRY & ENGINEERING CO., LTD., & NEWTON BROS. (DERBY), LTD.—Winding up voluntarily. Liquidator, Mr. H. C. Waddington, Trafalgar House, Waterloo Place, S.W.1, appointed January 15th. (These companies have amalgamated under the title "Haslam & Newton, Ltd.") Meetings of creditors are called for February 6th at the liquidator's offices. Particulars of claims to be sent in by February 20th. (This notice is purely formal. All creditors have been or will be paid in full.)

MOTOLITE DYNAMOS, LTD.—A meeting of members is called for February 25th, at Landor Road Works, Shepherd's Bush, W.12, to hear an account of the winding up from the liquidator, Mr. L. S. Challis.

ACOCKS GREEN ELECTRICAL STORES, LTD.—A meeting of members is called for March 6th at 3, Warwick Passage, Corporation Street, Birmingham, to hear an account of the winding up from the liquidator, Mr. F. E. Bendall.

BOLTON WIRELESS INSTALLATION, LTD.—A meeting of members is called for February 25th, at 9, Infirmary Street, Bolton, to hear an account of the winding up from the liquidator, Mr. J. Morris.

Private Arrangements.

Mrs. D. GLOVER (or Johnson), trading as D. Johnson, electrical and wireless dealer, 71, King Street, Wallasey, Ches.—A meeting of creditors was held recently at the offices of Mr. P. S. Booth, Exchange Chambers, Bixteth Street, Liverpool. A statement of affairs was presented which disclosed ranking liabilities of £1,000 and net assets of £450, leaving a deficiency of £550. The debtor had previously, for 15 years, carried on business as a hardware dealer. She started the present business in 1925 with £185 in cash, and a stock of electrical sundries valued at £100, and had traded at a loss. Mr. Booth said that no offer was put forward. He thought that if the turnover could be kept up to £60 a week, the business could be made a paying concern, and sold. A resolution was passed in favour of the matter being dealt with under a deed of assignment, with Mr. Booth as trustee, together with a committee consisting of the representatives of Messrs. Baxendale and Co., Ltd, the Chloride Electrical Storage Co., Ltd., and Rowe Bros. & Co., Ltd. The following are creditors:—

	£		£
Baxendale & Co., Ltd. ...	55	Hathaway, S., & Co. ...	28
Chloride Electrical Storage Co., Ltd.	94	Johnson W. B.	295
Downes & Davies	34	Owens, J.	28
Electric Lamp Factors	47	Rowe Bros. & Co., Ltd.	46
Ferguson, J., & Sons ...	20	Smith & Cookson	39
		Toubkin, J.	34

P. JONES and J. H. MERCER, trading as the Northern Wholesale Electrical Supply, electrical and hardware dealers, 266 and 268, Holloway Road, N.7.—A meeting of creditors was held on January 24th at the offices of Messrs. Sunderland, Mountstephen & Co., 15, Eastcheap, E.C. Mr. Sunderland submitted a statement of affairs which showed liabilities of £903, and net assets of £1,101, leaving a surplus of £198. Mr. Sunderland said that there were three suing creditors, and as one was in a position to levy execution, a deed of assignment had been taken in order to protect the assets. The business was commenced last March. Full records had not been kept; and the usual trading figures could not be presented. Mr. Jones possessed separate assets, and if the partnership estate did not produce sufficient to pay 20s. in the £, then Mr. Jones's private estate would be liable. A resolution was passed confirming the deed already executed to Mr. Sunderland, and a committee was also appointed. The following are creditors:—

	£		£
A.E.G. Electric Co., Ltd.	55	Spencer, T. E. & S., Ltd.	24
Electro Services, Ltd. ...	40	Toubkin, J.	143
Kapton Engineering Co.	30	Wilkinson, L.	41
Lee, Albert, & Co. ...	42		

Dissolution of Partnership.

DOWN & ABBOTT, electrical engineers and contractors, Barnard Castle.—Mr. A. Down and Mr. J. W. Abbott have dissolved partnership. Mr. Abbott will attend to debts and continue the business under the style of Electrical Engineering and Supply Co.

Price Reduction.

The GENERAL ELECTRIC CO., LTD., has reduced the price of its "Magnet" two-way adaptor. This is a very useful household electrical accessory—a two-circuit parallel adaptor with bakelite body and a switch integral with it to control the light.

Book Notices.

"Underground Cable Systems." By G. W. Stubbings. Pp. vii+216; figs. 106. London: Chapman & Hall, Ltd. Price 15s. net.

"Omnibus Lighting and Starting." By J. W. Houghton. (Reprint of a series of articles from *Motor Transport*.) Pp. 49. London: The Fanfare Press.

We have received from Mr. J. E. Dodsworth a copy of his "Engineers' Diary," now in its eighth year. It is well bound in black morocco leather, and in addition to the usual diary pages, ample space is provided for memoranda. It also contains a foreword by Sir Robert A. Hadfield, and a considerable amount of statistical information. A number of pages of squared paper add to its usefulness. The diary is published by Charles Letts & Co., and is obtainable at all stationers.

"Electric Drive Practice," by Gordon Fox. Pp. vii+421; figs. 170. London: McGraw-Hill Publishing Co., Ltd. Price 17s. 6d.

"*Mechanical World* Year Book, 1929." Pp. 348+clxvi; fully illustrated. London: Emmott & Co., Ltd. Price 1s. 6d. net.—The new edition of this popular handbook contains several new sections, including a contribution on helical springs. The work as a whole has been revised and brought up to date.

New Catalogues and Lists.

CHEERYHOUSES, LTD., 47, Sauchiehall Street, Glasgow.—Three illustrated pamphlets dealing with "Quickfix" lighting units and the "Dome" gallery, which obviates the use of screws. Priced.

The GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—Leaflet L.4,933, illustrating and describing "Geeko" lighting and starting accumulators. Priced. Also Catalogue Section F (3) containing illustrations, particulars and prices of the company's lighting glassware—bowls, shades, &c.

MESSRS. J. G. STATTER & Co., Queen Anne's Chambers, Westminster, S.W.1.—An illustrated pamphlet advertising e.h.p. standard oil switches (switchboard type).

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria Street, S.W.1.—Brochure No. 50E, containing a well-illustrated description of the construction and operation of La Cour motor-convertors.

MESSRS. J. BLAKEBOROUGH & SONS, LTD., Woodhouse Works, Brighouse (Yorks.).—List 112, dealing in some detail with the company's revolving screens for power station water systems, &c. Illustrated.

MESSRS. HANS RENOLD, LTD., Didsbury, Manchester.—An illustrated catalogue of chain drives. Priced.

THE SLOAN ELECTRICAL CO., LTD., 8-12, Golden Lane, E.C.1.—A 174-page catalogue of all kinds of electrical accessories, bell apparatus, domestic appliances, lighting fittings, &c. Illustrated and priced.

MESSRS. FALK, STADELMANN & Co., LTD., 83-93, Farringdon Road, E.C.1.—Catalogue No. 612, a comprehensive list (243 pp.) of electric lighting fittings. All classes of electroliers, bowls, brackets, shades, pendants, standards, &c., are illustrated, and prices are given in each case. Also Catalogue No. 613, dealing with glass shades for electric lighting.

MESSRS. T. B. MORLEY & Co., LTD., Jameson Street, Hull.—A price list, fully illustrated in colours, of "Morco" glassware for lighting purposes.

VENNER TIME SWITCHES, LTD., 45, Horseferry Road, S.W.1.—List No. 48, containing illustrated particulars of the "Venner" solar dial for use with street-lighting, &c., time switches, with notes on its application in various areas of the country. Prices are given.

MESSRS. WORTHINGTON-SIMPSON, LTD., Queen's House, Kingsway, W.C.2.—Bulletin No. WS.1095.B, dealing with the company's centrifugal pumps for condensing plants. Illustrated.

THE REVO ELECTRIC CO., LTD., Britannia Works, Tividale, Tipton, Staffs.—A showcard (12 in. by 17 in.), depicting a lady and her pets basking in the glow of a "Revo" electric fire.

THE BASTIAN METER CO., LTD., Farnham Road, Trading Estate, Slough.—Leaflet 03, containing illustrated details and prices of the company's water heaters, fires, grills, &c.

Calendar.

The calendar of Messrs. GEORGE NOBBS, LTD., 89, Cleveland Street, W.1, bears a very handsome colour drawing on silk by W. H. Margetson.

Proposed Sale of the Shanghai Undertaking.

The Shanghai correspondent of *The Times* reports that negotiations are on foot with a view to the sale, if the ratepayers approve, of the Municipal Electricity Department of the International Settlement to an Anglo-American syndicate of engineering and financial interests, including, it is understood, the Westinghouse Company and Metropolitan-Vickers, among others. One British representative is already in Shanghai, two American engineers are on their way, and Mr. Brooke Smith, formerly the chairman of the Municipal Council, representing one British group, is due there on February 22nd. The capital outlay of the Department has amounted to 35,000,000 taels (about £4,375,000), not including the land, which is most valuable, and the net return, after meeting all loan and other charges, is about 8½ per cent. As, however, depreciation is always allowed on the most liberal scale, and everything is in perfect condition, the value of the property is much greater than these figures suggest. Uncertainties regarding the future status of Shanghai make it desirable to safeguard the Municipal debentures, amounting to about 53,000,000 taels (£6,625,000). A further consideration is the fact that the Council's credit is undeniably affected by recent political events, and while the amount of loans outstanding is not great compared with its resources, considerable commitments, resulting from the rigid parsimony necessarily pursued during the past three years, are inevitable in the near future. These will be more easily met if the present indebtedness is wiped out, and this would be made possible by the sale of the Electricity Department.

Glasgow and Austrian Cable.

Glasgow Corporation on January 21th discussed the placing of a contract for the supply of 50,000 yards of cable for the Watching and Lighting Department. The figure quoted for Austrian cable by the British Electrical and Manufacturing Co., the successful tenderer, was £562 10s., and, according to a member, the lowest British offer was only 14 per cent. above this. For that difference, he said, they proposed to send the order to Austria, where the conditions were admittedly the cheapest throughout the whole of Central Europe. British Dominions gave a preference to British goods; would the Corporation not give the same preference? Allegations of the existence of a "ring" of manufacturers were made by the convener of the Committee, who said that seven or eight firms offered the material at almost identically the same price. By 30 votes to 27 the Committee's recommendation was approved.

Trade Announcements.

From the STERLING VARNISH CO., of 196, Deansgate, Manchester, we have received a New Year advertising novelty in the shape of a British made folding 12-inch steel rule and a pair of callipers in leather pocket case. The company recently floated a small company under the name Sterling Properties, Ltd., to take care of the Sterling Varnish Company's European interests. Mr. Reginald Barker, who has been with the company at their office in Manchester for over 20 years, was appointed manager in March, 1928, and he is chairman of directors of Sterling Properties, Ltd.

The CREDENDA CONDUITS CO., LTD., has appointed Mr. G. C. Wright, 10-11, St. Helen's Road, Swansea, as its agent for the Swansea area, South Wales. He will carry stocks of the company's domestic appliances, conduit, conduit fittings, cable, &c.

The GENERAL ELECTRIC CO., LTD., has opened a new branch at Blackpool. It is situated in Birley Street, and the premises are known as "Magnet House." The Singapore branch of the company has been moved from 5 to 12, Battery Road.

Catalogues Wanted.

Messrs. BAILY, GRUNDY & BARRETT, LTD., electrical engineers, Whithorne House, North Street, Midhurst, Sussex, ask for lists and catalogues.

Foreign Trade Volumes and Values.

In the *Board of Trade Journal* dated January 24th the volumes and values of exports and imports during 1928 are compared with those of 1924. It is shown that although the value of exported electrical goods and apparatus in 1928 was only 94.5 per cent. of the 1924 value, the volume was 115.2 per cent. of the 1924 volume. In the same way, while the value of electrical goods and apparatus imported during 1928 was only 89.3 per cent. of the 1924 value, the volume was 156.4 per cent. of the 1924 volume.

An Egyptian Buyer's Guide.

We have received from Mr. A. Brookes, 3, Mehemet Aly Square, Alexandria, a quarterly publication entitled "Who's the Agent?" In this manufacturers of all classes of goods are shown in appropriate sections, and the names of their Egyptian and Sudanese agents are given. A form enclosed with the guide facilitates the securing of free entries by manufacturers.

The British Industries Fair.

The Prince of Wales is to be present at the Government banquet to be held at the Mansion House on February 18th, the opening day of the British Industries Fair in London and Birmingham. The Prime Minister has also notified his intention of being present, and the chair will be taken by the President of the Board of Trade, Sir Philip Cunliffe-Lister, M.P.

Large American Power Development.

A grouping of the power system in a number of American States representing a capital of two billion dollars is predicted in financial circles as the ultimate outcome of the creation of the "United Corporation" which was announced last week. The new corporation is to have a capital of 260 million dollars and it is learned that its plans include the acquisition of holdings in a number of New York and New Jersey utility corporations. While the grouping will be kept within State boundaries so that the companies affected will each be under the jurisdiction of its own State Public Service Commission, the organisation is expected to extend not only to New York and New Jersey, but also to Pennsylvania, Delaware, Maryland, and a number of New England States.—*Reuter* (New York).

For Sale.

Mr. G. R. Lightfoot will sell by auction on February 14th, at 13, High Holborn, W.C., a quantity of electrical and wireless material. Aberdeen Corporation Electricity Department has for disposal several Babcock & Wilcox brick-built land-type boilers; Manchester Corporation Electricity Department invites offers for a large quantity of 200-V electric lamps. (See our advertisement pages to-day.)

The German Installation Material Industry.

It is stated that the production of electrical installation materials in Germany has for a long time past met with exceptional difficulties. One of the main causes is the overproduction which prevails owing to the lessened possibility of effecting sales abroad, this being reflected in the home market by depressed prices and decreased activity. It is calculated that the future will be still more unfavourable as export conditions have become more difficult through the competition of countries with a depreciated currency and through the high duties now being imposed.

New Zealand's Electrical Imports.

The value of the electrical machinery imported into New Zealand during November last is returned at £164,400, as compared with £155,430 in the corresponding month of 1927.

J. H. Holmes & Co.

The trustees under the deed of assignment report that the businesses of J. H. Holmes & Co. and W. H. Holmes & Sons were carried on by them and eventually sold, with certain exceptions, for £50,000. The debtors are not in any way interested in the new companies, which were formed to acquire the two businesses. There are still many outstanding book debts to be collected, and certain electrical contracts to be completed before the estate can be finally wound up. A meeting of the creditors to receive a report of the winding up was to be held on Wednesday last. It is proposed to pay immediately a first dividend of 6s. 8d. in the £. The trustees are Messrs. J. Miller & Jeffrey Taylor, Gibb Chambers, Westgate Road, Newcastle-upon-Tyne.

The B.E.A. and the "Mond" Conference.

In a long statement issued this week, the British Engineers' Association puts forward its objections to the proposal of the "Mond" conference to form a National Industrial Council to deliberate upon matters affecting industry. It considers that undue influence would be given to the Trades Union Congress, and the result would be that representatives of non-political employers' organisations would be brought into conference with men who are virtually representatives of the Labour Party. The employers would be called upon to supply information regarding their business which has hitherto been confidential. The only means of making such a conference successful would be for the trade union representatives to repudiate the Socialistic policy of the Labour Party.

Prices of Raw Materials.

Reporting on the lead market on January 26th, Messrs. James Forster & Co. stated:—"Conditions are unchanged. Demand from consumers continues to be very moderate; on the other hand, supplies during the next few weeks are not expected to be large. Consumption keeps up well, but shows no signs of expanding at present. According to Board of

Trade returns the total left for home absorption in 1927 exceeds that of 1928 by 38,453 tons, but seeing that the invisible stocks in this country in the former year increased by about 30,000 tons, whereas last year consumption absorbed at least 20,000 tons of that stock, it appears that consumption actually improved last year to the extent of 12,000 tons, or 1,000 tons a month."

We have received from Messrs. M. H. CAWSON & Co., 60, Gracechurch Street, E.C.3, a chart showing the net average monthly market prices of soft pig lead from 1913 to 1928. This indicates that the average price during last year was lower than in any year since 1913.

Messrs. F. Smith & Co. report, January 29th :—No change in the price for electrolytic copper.

Messrs. James & Shakespeare report, January 29th :—Copper bars (best selected), sheet and rod, £104, £2 inc.; English pig lead, no change.

Messrs. Edward Till & Co. report, January 29th :—India-rubber, Para fine, 10⅞d., ⅛d. dec.

Lighting and Power Notes.

Argentina.—SANTA FÉ.—The municipality of Santa Fé, which supplies electricity to the southern part of the town, is faced with the fact that the existing plant has become inadequate for the load and the extension of the area supplied. The building of a new generating station is for the moment out of the question due to the high cost involved and the present state of the municipal finances. Consideration is to be given to the possibility of improving the distribution system and authorisation is sought to take electricity from outside suppliers while the matter is under review. The remainder of the town, not supplied by the municipal station, is covered by the Atlas Light and Power Co., which has practically completed the installation of a new 12,000-kW power station.

Bexhill.—NEW MAINS.—The Corporation Electricity Committee has recommended the expenditure of £3,300 for a new feeder main and £4,183 for distributors.

Bicester.—ELECTRICITY SUPPLY.—The Urban District Council has received from the Electricity Commissioners an intimation that the application of the West of England Electricity Co., Ltd., for a Special Order has been refused, and that the application of the Wessex Electricity Co. has been granted.

Birmingham.—ELECTRICAL DEVELOPMENT.—The *Birmingham Post* reports that the foggy weather which has prevailed in Birmingham during the last few days has led to a marked increase in the demand for electricity in Birmingham. All previous "records" were broken on January 22nd, when the output from the power stations amounted to 1,750,000 kWh in the 24 hours. These figures represent an increase of 30 per cent. on the corresponding day of last year. At a recent meeting of the Electric Supply Committee it was reported that the sales of electricity during the December quarter showed an increase of 8.8 per cent. over the corresponding period of 1927. An additional 1,063 consumers were coupled up to the mains during last month, representing 12,000 extra lights and about 3,500 h.p. in power supplies. A number of satisfactory agreements for bulk supplies to works were also approved.

Brighton.—NEW SUB-STATION PLANT.—The Corporation electrical engineer has recommended that, to meet the additional business in the Portslade and Southwick areas, the least efficient unit at the local sub-station be replaced by a Bruce Peebles-La Cour motor convertor of 1,000-kW capacity, and that a second unit of similar capacity be installed at a later date. The cost of this new unit is £4,609, with an additional £1,380 for switchgear, &c. The Lighting Committee has authorised the engineer to place orders for the necessary plant, foundations, &c.

NEW SWITCHGEAR.—The engineer has also submitted a report on the installation of new switchgear and the re-conditioning of the present switchgear at Southwick and North Road, suitable for working with the National "grid" system at a total estimated cost of £55,410. The approval of the Electricity Commissioners and the Central Electricity Board is to be obtained before placing contracts for the work.

SUPPLY TO FILM STUDIOS.—The Lighting Committee has made the following agreement for a supply of electricity to the proposed film studios at Whitehawk Valley: The Corporation to erect a new main overhead with underground crossings where necessary from the Kemp Town sub-station to a sub-station to be provided at the expense of the company in a suitable position adjacent to the studios. The supply to be afforded and metered at this point at 8,000 V, 3-phase, 50 cycles. The company to guarantee a minimum account of £3,000 during the first 18 months from the date of connecting up the supply, and thereafter a minimum account of £3,000 per annum for a further four years. The maximum demand which the company will be entitled to make will be 1,000 kW during that period unless the agreement is revised by mutual arrangement. The supply as metered will be charged at the rate of .625d. per kWh, subject to a fuel clause.

Canada.—SASKATOON.—The City Council has approved the final draft of an agreement with the Government of Saskatchewan providing for the sale of the municipal power plant to the Government and the erection by the latter before next autumn of a new 10,000-kW plant, from which electricity will be supplied for distribution in Saskatoon and in the surrounding country districts. The generating station at Saskatoon is expected to become the nucleus of a northern system of distribution of electrical energy in Saskatchewan. The Saskatchewan Power Commission, appointed by the Provincial Government, strongly recommended in a report presented last July, the immediate purchase of the municipal plants at Regina, Moose Jaw and Saskatoon as the initial step in the development of a provincial scheme of power distribution.

Continental.—GERMANY.—Work on the establishment of a new 80,000-kW steam-operated power station near Cosel, Upper Silesia, is about to be commenced.

SWITZERLAND.—The latest report from Argovie says that it is proposed to construct the Klingau works at the same time as those of Wildegg-Brugg. The annual yield of Klingau will be 190 million kWh, and of Wildegg-Brugg 240 million kWh. The former will cost 30 million francs to set up, the latter 40 millions. The seat of the new company will be at Brugg, and the canton of Argovie will be responsible for 35 per cent. of the capital, the Crédit Suisse for 5 per cent., and the electricity works of N-E. Switzerland, of Berne, and of the Motor Columbus for 35 per cent. The Rhenish-Westphalian electric works will receive all the energy from the two stations at 2 centimes per kWh, but whenever the Swiss groups demanded it, they would be obliged to supply two-thirds of the energy for three centimes per kWh. But the matter is by no means settled yet.

FRANCE.—According to a return recently published by *Slectricité et Mécanique*, out of 37,981 small towns and villages throughout France, 19,871, or about 52 per cent., are now provided with an electricity supply.

Costa Rica.—HYDRO-ELECTRIC DEVELOPMENT.—By presidential decree, a National Electric Power Service has been created to superintend the construction of works to generate electricity from water-power. All potential sources of over 500 h.p. will be developed by the Power Service. Existing concessions will be terminated at the end of the period for which they were granted, and the right to grant new concessions for the development of less than 500 h.p. will become the exclusive prerogative of the Power Service. The Service is also authorised to purchase plants now producing 3,000 h.p. or more, construct a plant producing at least 10,000 h.p. to serve the plateau section, and establish other plants in different parts of the State.—*Reuter's Trade Service* (San Jose).

Croydon.—ELECTRICITY EXTENSIONS.—The Corporation Electricity Committee has prepared a scheme for extensions as follows: Works, £4,300; distribution, £47,862; mains, £12,000.

Dundee.—NEW PLANT.—Mr. D. H. Bishop, Corporation electrical engineer, has reported to the Electricity Committee that another pumping station is now required and that the coal handling plant will have to be extended. The load has reached the stage when extensions are absolutely necessary. The estimated cost of the pumping station is £24,700. The amount of coal handled is increasing annually, and the estimated cost of the extension, with equipment for handling coal mechanically, is about £44,000. The question has been raised whether, under the new conditions applying to the supply of electricity, the capital expenditure is justified, but Mr. Bishop points out that the Central Board expects Dundee to generate 108 million kWh per annum, and it cannot hope to comply with the wishes of the Board with the plant at present installed. The Committee has recommended the expenditure of £70,000 for extensions.

East Anglia.—INQUIRY.—The inquiry which was adjourned at Norwich in July last into the applications of Norwich, Great Yarmouth, Ipswich, and King's Lynn Corporations, and Mr. F. R. Hunter, for Special Orders to supply electricity in certain areas in Norfolk and Suffolk, and a scheme prepared by the East Anglian Electricity Supply Co., Ltd., for the development of electricity supply under its Act of 1927, was reopened by Col. Ekin for the Electricity Commissioners at Savoy Court, Strand, W.C., on January 22nd. According to the *East Anglian Daily Times*, in submitting the company's scheme, Mr. Spencer Hawes, consulting engineer, said that there was no provision for a generating station. It rested on the provision by the Central Electricity Board of the main transmission lines as part of the grid in Norfolk and Suffolk, and on the available sources of supply in the district in the meantime. Supplies would be taken from the big towns which would be in touch with the grid. The present system of the company's supply was mostly d.c. This was being changed over to a.c., and when the complete scheme was in operation it intended to change over the whole of its direct-current supply. There would ultimately be a total of 280 miles of 33,000-V transmission line, and alongside part of the line there would be an 11,000-V line as well; these lines were to be tapped immediately at convenient places *en route*. The scheme of h.p. mains indicated by him would give the company a transmission system which would fit in with the grid

scheme of the Electricity Board when it came along. The estimated cost was £715,000. At the resumption on January 23rd, Mr. Hawes said that Part I of the company's schedule showed 51 parishes in which mains would be laid within two years, and Part II showed 64 other parishes in which the company would lay mains as a reasonable demand arose. By the fourth or fifth year all these places would be receiving a supply. Mr. S. G. Turner, for Ipswich and Norwich Corporations said that these authorities were capable of dealing with the requirements of the areas for which they sought powers to supply. Ipswich Corporation was prepared to go forward with its development at once. For King's Lynn Corporation, Mr. J. H. Thorpe stated that within six months of its securing an Order, the Corporation could supply Hunstanton with electricity. The inquiry was closed.

Forres.—ELECTRICITY SCHEME.—The Town Council is negotiating with a London company for the installation of electric lighting in the burgh. Under the proposed agreement, the company will install the plant free of charge, and the price to the consumers will be 8d. per kWh.

Glasgow.—ELECTRICITY CHARGES.—At a recent meeting of the Corporation Electricity Committee the town clerk reported that it had been remitted to a special sub-committee to consider and report on the whole question of the charges at present made for electricity, and the manager has been asked to prepare a revised scale of charges for consideration at a future meeting.

CHANGE OF FREQUENCY.—The Corporation Electricity Committee has instructed the manager to proceed with the general preliminaries in connection with the change of frequency in No. 2 area (north-west district of the city), and to submit a report on the details of the work.

Glossop.—MAXIMUM CHARGE.—At a recent meeting of the Corporation the town clerk reported the receipt of an Order from the Ministry of Transport fixing the maximum charge for electricity in the borough at 8d. per kWh, and stated that an agreement had been entered into with the Urban Electric Supply Co., covering the other points raised in the recent settlement arrived at between the company and the Corporation.

Grimsby.—EXTENSION OF SUPPLY.—The Corporation Electricity Committee is applying for sanction to a scheme for the supply of electricity to Louth and permission to erect an overhead line in connection with the supply from Holton-le-Clay to Louth, at an estimated cost of £10,160.

Ilford.—LOAN.—The Corporation Electricity Committee is applying for sanction to a loan of £5,000 for wiring installations on hire.

Inverness.—PRICE REDUCTIONS.—The Corporation Electricity Committee has recommended a reduction in electricity charges from 7d. to 6d. per kWh for lighting, and from 2½d. to 2d. per kWh for power.

London.—FULHAM.—The borough electrical engineer reports that plans are in course of preparation for an underground sub-station at Bishop's Meadow, to relieve the district between the junction of Fulham Palace Road with Fulham Road and Harford Street. The estimated cost of the scheme is £3,000.

In connection with the proposed erection of 44 tenements at Harwood Road, Fulham, the L.C.C. is to consider the possibilities of the installation of electricity for cooking, heating, &c., as well as lighting on lines similar to those at the Ossulston Estate, St. Pancras.

ST. MARYLEBONE.—At the request of the Electricity Commissioners the Borough Council Electricity Committee has considered a proposal to take additional bulk supplies as an alternative to plant extensions, but has decided that, so far as the immediate future is concerned, the extension of plant is desirable. It therefore recommends the following extensions and consequential arrangements at the power station, and that application be made for the necessary sanction: (1) The installation of two 20,000-kW turbo-alternators, together with the requisite boiler plant, &c., at an estimated cost of £471,900, and (2) the scrapping of three 2,000-kW d.c. Parsons' sets, one 3,000-kW Oerlikon turbo-alternator, with auxiliaries, and two boiler feed pumps. The Committee has also recommended extensions of cables, switchgear and transformers, at a total estimated cost of £115,652, made up as follows: Trenching, provision of ducts and re-instatement, £32,347; e.h.p. cables, drawing-in and jointing, £47,544; switchgear at generating station, sub-stations, and transformer stations, £26,291; transformer groups, £9,470. The Finance Committee has recommended that application be made for sanction to loans for the above purposes.

The Committee has recommended that application be made to the London County Council for temporary consent to an alteration of the standard pressure and system of supply to 240 and 415 V, 3-phase, 50 cycles, to permit a change of the system of supply from d.c. to a.c. in the borough, where possible.

HACKNEY.—The Borough Council Electricity Committee has recommended that from April 1st next consumers under the prepayment-meter scheme be given the alternative of 1s. or 1d. in the slot meters, and that one 40- or 60-W lamp be allowed to each consumer under the prepayment meter scheme for each 100 kWh consumed for lighting purposes.

Mexico.—HYDRO-ELECTRIC DEVELOPMENT.—A group of Mexican engineers and capitalists has organised a national co-operative hydro-electric company to supply electricity to agriculture and several small industries. The company, which holds a Government concession, will utilise sources of hydro-electric power in different parts of the country from which it is estimated that 10,000,000 h.p. can be developed; only 300,000 h.p. is being used at present. The company's concession is for 60 years with a variable capital which may be increased to 6,000,000 pesos.—*Reuter's Trade Service* (Mexico City).

Pontefract.—INQUIRY.—The inquiry which is to be held on February 4th into the joint petition of the local Chamber of Commerce and the Town Council for a compulsory revision of the maximum charges for electricity in the borough made by the Yorkshire (West Riding) Tramways Co., Ltd., has now been fixed by the Electricity Commissioners for February 13th.

Stewartry.—OPPOSITION TO SCHEME.—The County Council at last meeting decided to oppose the electricity scheme of the Galloway Water Power Co. The Council stipulates that it should have more favourable terms, and that a supply should be made available at any of the power stations, and also at convenient points on the Company's own transmission lines throughout the county at the same pressure at which the Company supplies electricity to the main lines of the Electricity Board.

Tramway and Railway Notes.

Argentina.—RAILWAY ELECTRIFICATION.—An official notification has been issued authorising the electrification of the Central Argentine Railway in accordance with the proposals of the company.—*Reuter* (Buenos Aires).

Chester.—POLL OF RATEPAYERS.—The City Council is to take a poll of ratepayers on the question of promoting a Parliamentary Bill authorising the substitution of omnibuses for the present tramway system.

Colombia.—NEW RAILWAY.—The Ministry of Public Works announces the Government's intention to proceed in the immediate future with the construction of the remaining 2,400 km. of railway, which will complete a 5,000-km. project. It has not yet been decided whether the railway shall be electric or steam, but the gauge, maximum grades and curves will be such as to guarantee minimum freight rates, high speed and low cost of construction and operation. It is understood that the Government has received proposals from the Société Nationale de Chemins-de-Fer en Colombie, which holds a concession for the construction of the Ferrocarril-de-Nordeste.—*Reuter's Trade Service* (Bogota).

Continental.—ITALY.—The Genoa correspondent of the *Financial Times* reports that the final adjusted results of the State railways for the financial year ended June 30th last show a surplus of 110,145,000 lire. The consumption of electricity for the operation of the electrified lines was 296,695,000 kWh, as compared with 241,696,000 kWh in the preceding year, and the expenditure for electricity was 47,570,000 lire. It is estimated that the haulage of the same traffic by steam locomotives would have meant an increase in expenditure of 22,150,000 lire. The total length of lines now electrified is 1,176 km., and work is proceeding with the electrification of a further 600 km.

SWITZERLAND.—The Swiss Federal Railways have decided to provide their rolling stock, within the next six years, with the Drolshammer new continuous brake, and a very satisfactory demonstration of its use for goods trains has been given on the steep section from Airolo to Castione. This will cost the Government 15 million francs, but as the new brake will do away with brakesmen, it will be a saving in the long run. The Drolshammer has been passed as sound by the Union Internationale des Chemins de Fer, and is in every way suited to electric traction.

London.—BECONTREE FACILITIES.—The Housing Committee of the L.C.C. has considered proposals by the L.M. & S. Railway Co., for improved transport facilities on the Southend line as far as it affects Becontree. The proposals include a service of electric trains by the extension of the existing electrified lines from Barking to Dagenham and the running of electric trains from and to stations on the Metropolitan District Railway. The company would widen this part of the Southend line to obtain two additional tracks equipped for electrical working, which would be capable of maintaining a maximum service of 40 trains an hour. The Committee has recommended that, subject to satisfactory assurances from the company that the works will be carried out with all possible expedition, no opposition be offered to the proposals in so far as they relate to Becontree.

TRAMCAR IMPROVEMENTS.—The Highways Committee has recommended that improved and re-arranged seating and other improvements be made on 549 tramcars at an estimated cost of £113,500.

SOUTHAMPTON ROW SUBWAY.—At a meeting of the L.C.C. on January 22nd, it was stated that the work of deepening the Southampton Row tramway subway would be commenced in June next, and it would be necessary to close the subway for about 18 months.

South Lancashire.—PARLIAMENTARY BILL.—A Bill to authorise the South Lancashire Tramways Co. to provide and run railless cars and omnibuses has been deposited for introduction into Parliament this Session, according to the *Financial News*. Under this Bill the company proposes to provide railless cars along the routes of the tramways and light railways owned and worked by it, and also along other routes in prolongation of the existing tramways in the rural districts of Leigh and Burton-upon-Irwell. Upon the equipment of the apparatus being provided for working the railless cars, the company "may abandon the whole or any part of its tramways upon giving one month's notice to the road authority." The period sought within which to complete the railless-car equipment is five years from the passing of the Act, and if and so long as the services of transport provided by the company shall meet the requirements of the routes it shall not be lawful for any other company or for any local authority or person to run omnibuses along the routes in competition with the services of company. The capital of the company, which is proposed to be hereafter known as "The South Lancashire Transport Co.," is to remain at £1,450,000, with borrowing powers not exceeding £482,600.

United States. — RAILWAY ELECTRIFICATION. — Messrs. Dominick & Dominick, of New York, in the current issue of their *Review* state that the total length of electrified railway actually completed in the United States amounts to about 1,800 miles of railroad and 4,000 miles of track. This is confined to 19 different railroads, however, and represents only 7 per cent. of the entire railroad mileage of the country. Electrification will make it possible to handle a greater volume of traffic in a shorter period of time. The announcement of the Pennsylvania plan pointed out that by 1950 the metropolitan area round New York might extend to New Brunswick on the west and well out on Long Island on the east, and contain 30,000,000 people. There would be a similar development in other cities. Through electrification, the Pennsylvania plans to reduce the number of freight trains 50 per cent. for a given car movement, and increase the speed to any reasonable extent required. This of itself would double the capacity of the freight movement. In addition to the greater capacity of electrical operation completed, projects of electrification have indicated that the actual cost of operation will be less. For example, in 1924, the last full year previous to its electrification, the Virginia Railway had a total operating cost of 40.24 cents per hundred net ton-miles; in 1927, the first full year subsequent to electrification, this cost was 35.74 cents. The decrease in operating cost was 11.2 per cent.

Telegraph and Telephone Notes.

Argentina.—TELEPHONE DEVELOPMENT.—The entire telephone network in Posadas (Argentina), consisting of an antiquated exchange in the capital and an overhead line to Candelaria, twenty miles away, has been sold to the Compãnia Internacional de Telefonos S.A. The system is being entirely rebuilt, and conversion to automatic working is to be completed in March, 1930; the new automatic exchange will have capacity for an ultimate number of 5,000 subscribers, but the initial equipment will provide for only 500 lines. The Cia. Internacional, which operates an automatic system in Asuncion, has extended its lines to several of the principal towns in the Republic. The new system in Posadas is to be linked with Paraguay by means of a cable across the Parana to Encarnacion and thence to Asuncion. Considerable development is expected to take place in the provinces of Misiones, Corrientes, and Entre Rios, and connection with Buenos Ayres is probable within a year or so. The Cia Internacional is also installing automatic systems at Corrientes and Reconquista.

Australia.—PHOTOTELEGRAPHY.—It is reported that the British General Electric Co., Ltd., has secured a contract for the telegraphic transmission of pictures between Melbourne and Sydney, the first experiment of its kind in Australia.

China.—AUTOMATIC TELEPHONY.—Automatic telephones in Harbin having proved so successful, it is reported that the Chinese Eastern Railway is considering the installation of similar equipment in other towns along that railway.

Marine Wireless Stations.—KINNAIRD HEAD BEACON.—The automatic wireless beacon at Kinnaird Head, Fraserburgh, which has a range of a hundred miles, has been completed, and the first tests have been successfully carried out by representatives of the Marconi Company. The station may be identified by the call signal MMK, and it operates on a 1,000-metres wave-length. All the machinery is duplicated, and power is obtained from two 5-h.p. kerosine engines and storage batteries.

SPARK STATIONS.—The General Post Office is gradually replacing the spark wireless telegraphy sets at its coastal stations with interrupted-continuous-wave instruments, which have already been installed at Seaforth (near Liverpool), Niton (Isle of Wight), North Foreland, and Mablethorpe. This year the change will be made at Cullercoats, Northumberland, Fishguard, and Wick.

The Telephone Service.—LONDON.—The statement of progress during 1928, prepared for the London Telephone Advisory Committee, indicates that international communication has greatly developed both by cable and wireless; a second transatlantic radio channel was inaugurated, and the total number of Continental and transatlantic calls rose from 288,743 to 424,045. Continental traffic increased by 30 per cent., and calls to and from America numbered 358 in September, 519 in October, and 456 in November. Of the 130 exchanges, 119 were manual, seven automatic, two toll, one trunk, and one tandem. The number of exchange lines was 355,983, the increase being 8.8 per cent., in addition to 15,590 private lines. The total number of telephones (exchange and private) was 614,183, an increase of 8.6 per cent. Over 26,000 private branch exchanges were in use in the London area, 25,920 being manually operated and 124 automatic. The number of call offices was 5,512, the increase being 436, and the number of kiosks erected was 459, the total now being 1,214. Within the inner London area six additional automatic exchanges were opened, *viz.*, Bishopsgate, Sloane, Bermondsey, Monument, Mansion House, and Welbeck, having an equipped capacity of 37,200 lines; during 1929 some 14 other automatic exchanges will be brought into service, with an equipment capacity for 76,100 subscribers. In addition, specifications have been issued for exchanges with a combined initial capacity for 45,000 exchange lines, and the total to be constructed in London during the next five years is 47. New manual exchanges opened numbered 11, and early in 1929 manual exchanges (five) will be opened to afford relief in congested areas pending further developments of the automatic system, and will have an increased initial capacity of 23,000 and an ultimate capacity of 37,000 subscribers' lines. The equipment of 25 of the existing exchanges has also been increased by 20,000 lines, while extensions at 33 other exchanges will give a further increase of 36,500 lines.

The construction of 23 new exchange buildings was in hand (seven manual), and sites had been secured for 21 exchanges, whilst search was proceeding in the case of 14 others. The London telephone directory contained over 330,000 entries. There were approximately 40,000 junction circuits, and the length of conductors in the cables provided for junction service was approximately 350,000 miles. The total mileage of single wire provided for subscribers' lines and local junctions was 2,672,977, an increase of 283,839 miles. There was an increase of 827 miles of conduit, the total being 10,260 miles. The length of open wire in London was 56,239 miles, carried on 5,795 miles of pole line. A fire in the Thames Embankment subway in September resulted in the destruction of 53 of the P.O. Department's cables carrying approximately 200 main trunk and telegraph circuits, 3,000 junction circuits, and 2,500 subscribers' and local circuits. Upwards of 20 of the Department's cables also suffered severely as a result of an explosion in Holborn at the end of December.

A repeater station was opened at Taunton and a similar one at Tavistock will be opened early in 1929; others were brought into service at Halesworth and Glasgow. A considerable demand arose during the year for circuits suitable for picture transmission between London and such provincial centres as Leeds, Manchester, Edinburgh, and Glasgow; they were provided in the main underground system by means of the repeaters already established.

The number of local calls was 592,460,717, an increase of 7 per cent., and the average number of inland trunk calls originated in London daily was 16,754; the increase in night trunk traffic of all classes was 8 per cent., and the average number of calls of all classes passing through the London trunk exchange daily (24 hours) was 65,729, also an increase of 8 per cent. The total daily toll traffic was 50,008, an increase of 7.7 per cent., and the total number of incoming and outgoing lines increased from 1,221 to 1,629.

The Telegraph Service.—PETERHEAD STATION.—The Post Office cable from Peterhead to Russia, which was installed in 1915, has been dismantled, and the property whereon the instruments were fitted has been handed back to the owners. The cable was of great service during the 1914-18 war, and at one time a staff of between forty and fifty was employed at the Peterhead station.

PHONOGRAMS.—The number of phonograms dealt with in 1928 was 1,980,000, an increase of 11 per cent. Registrants of abbreviated telegraphic addresses to the number of 3,176 have all their telegrams delivered by telephone, the total number dealt with being 450,000 annually. In addition, about 200,000 telegrams addressed to telephone exchange numbers were delivered by telephone.

Radio Notes.

Australia.—LICENCES.—The number of receiving licences in force in November, 1928, totalled:—

	Licences in force.	Increase.
Victoria	143,250	1,265
New South Wales	90,177	1,395
South Australia	22,019	505
Tasmania	3,946	91
		Decrease.
West Australia	3,830	14
Queensland	25,235	331
		Increase.
Commonwealth	288,457	2,910

FEDERAL OWNERSHIP.—An agreement has been reached by the Commonwealth Government and the Western Australian Farmers' Broadcasting Co. for the continuation of the "A" class station in Perth, 6WF, under Government ownership. It was known that the company was anxious to sell its interest in the enterprise, which had proved a very unprofitable venture, but the terms under which the Government had agreed to take it over have not been disclosed. The Postmaster-General (Mr. W. G. Gibson) said negotiations for taking over "A" class stations in the other States were being undertaken on behalf of the Government by the Broadcasting Advisory Committee.

Canadian Royal Commission.—VISITS TO EUROPE.—The Commission of Inquiry, which arrived in England on January 15th, is to be joined in this country by Sir John Aird, its chairman, whose sailing from Montreal was delayed. After studying broadcasting conditions in England, the Commission is to visit France, Switzerland, and possibly Germany, says *World-Radio*, before returning to consider the situation in Canada.

Jugo-Slavia.—NEW PLANT.—The 28 rooms in the building of the Academy of Sciences (Nauka) at Belgrade which are to house the new broadcasting company are nearly ready for occupation, and the Marconi apparatus from England is already being placed in position. Dr. Braun, formerly in the service of Ravag, is a director of the new company, and its general manager; tests will begin on February 1st with 6-kW energy, and the two aerial masts, 80 ft. high, are already erected on the roof of the premises. Hitherto South Slavia has been very ill-provided with broadcasting stations, that at Zagreb is only of 0.7 kW, but, according to *World-Radio*, Ljubljana (Laibach) is nearly ready now, with its Telefunken plant of 2.5 kW and masts 400 ft. high.

Licences.—STILL INCREASING.—In reply to a question in the House of Commons, Lord Wolmer, Assistant Postmaster-General, stated on January 24th that the number of wireless receiving licences in force on December 31st, 1926, was 2,178,430; on December 31st, 1927, it was 2,395,106; and on December 31st, 1928, approximately 2,628,000.

Rumania.—RESTRICTION REMOVED.—The ban that has existed since 1925 on the use of transmitting and receiving stations within a zone of 30 km. of the frontier has been removed. According to the *Wireless World*, after a long period of hesitation, Rumania has finally decided to adopt broadcasting, and it is hoped that a 12-kW station under construction at Otopeni, between Bucharest and Ploesci, will be working before the end of March. A provisional 400-watt transmitter is already in operation on 401.6 metres. According to the *Plan de Bruxelles* the station should be working on 223.9 metres.

Sweden.—LICENCES.—The number of receiving licences is steadily growing, the increase during the last three months of 1928 having been nearly 10,000, so that the total rose to 381,000, or 62.6 per thousand inhabitants.—*Reuter's Trade Service* (Stockholm).

United States.—BRITISH RELAYS.—British programmes are to be heard all over the United States in March by transmitting them by short waves across the ocean. The British Broadcasting Corporation's programmes are to be received at New York, says *The Times*, by the Radio Corporation of America at Riverhead, Long Island, which will amplify and pass them on to the National Broadcasting Company's distributing centre in Fifth Avenue, New York, whence they will be fed to the network of broadcasting stations extending from the Atlantic to the Pacific coasts. Arrangements are also being made for European listeners to hear American programmes.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Australia.—MELBOURNE.—February 26th. Posts and Telegraphs Department. Induction coils and registers for telephone work. (B.X. 5031.)*

February 19th. Dry cells and wet battery parts.

April 2nd. Jumper rings and terminal strips. (B.X 5066.)

March 18th. State Electricity Commission of Victoria. Insulators and accessories. (B.X. 4997.)*

April 8th. Galvanised steel transmission line towers. (A.X. 7401.)*

April 29th. Two or three steam turbo-generator sets with condensers for Yallourn Power Station extension. (B.X. 5062.)*

Ampthill.—February 4th. Board of Guardians. Electric wiring and fittings for heating of Board room.

Batley.—February 4th. Electricity Department. L.p. cable. (January 25th.)

Bedford.—February 22nd. Electricity Department. E.h.p., h.p. and l.p. cables, incandescent electric lamps. (See this issue.)

Belfast.—February 18th. Electricity Department. Materials for 12 months, including electrical accessories, lamps, carbon brushes, cables, joint boxes, meters, &c. (See this issue.)

Blackburn.—February 7th. Town Council. Electrical installation at Roe Lee School. Form of tender (deposit £1) from Mr. H. M. Webb, borough and water engineer.

Carlisle.—Electricity Department. One 15,000-kW turbo-alternator and condensing plant. (January 25th.)

Croydon.—February 7th. Electricity Department. 14,000 tons of coal suitable for use on chain-grate mechanical stokers. (January 25th.)

Dumfries.—February 21st. Electricity Department. One 1,500-kW turbo-alternator and condensing plant. (See this issue.)

Erith.—March 4th. Electricity Department. H.p. and l.p. cables, joint boxes, &c. (See this issue.)

Egypt.—CAIRO.—March 27th. Ministry of Interior. Supply and installation of an electric lighting system for the town of Fashu. (B.X. 5037.)*

Glasgow.—February 7th. Corporation. Electric lighting installation for the Shettleston Baths. Specifications, &c., from Public Works Office, 64, Cochrane Street (deposit three guineas).

Grimsby.—February 6th. Electricity Department. H.p. steam pipes and valves, circulating-water pipes and valves, water service pipes and valves. (January 25th.)

Halifax.—February 4th. Town Council. Electrician's work required in erection of 64 houses, Moor Road. Specifications, &c. (deposit £2 2s. each) from Mr. A. C. Tipple, borough engineer, Crossley Street.

Hendon.—February 11th. U.D.C. 29 closed circuit code signalling street alarms. (See this issue.)

India.—February 5th. Turbo-alternator set, condenser, boiler, economiser, switchgear and cables for the new power station, Delhi. (B.X. 4944.)*

Lancaster.—February 18th. Electricity Department. 400/600-Ah station battery with reversible booster, automatic switchgear, &c. (See this issue.)

Leeds.—February 4th. University. Electric wiring, &c., of the mining section of the University. (January 25th.)

February 15th. Electricity Department. Annual contracts for stores. (January 25th.)

February 8th. Board of Guardians. Electric light installation at Children's Block, Rothwell Institution. Form of tender from Mr. J. H. Ford, clerk to the Board of Guardians, Poor Law Offices, 11, South Parade, Leeds.

London.—CENTRAL ELECTRICITY BOARD.—February 15th. 66,000-V cables (London Area) in connection with the South-East England Electricity Scheme. (January 11th.)

February 18th. Supply, delivery and erection of 132,000-V overhead transmission lines in connection with the Central England and North-West England and North Wales Electricity Schemes. (January 4th.)

March 2nd. 66,000-V and other transformers (London Area) in connection with the South-East England Electricity Scheme. (See this issue.)

February 22nd. 132-kV outdoor switchgear for the transforming stations in the Central England Electricity Scheme area, 132,000-V transformers. (January 11th.)

March 4th. Supply, delivery and erection of 66,000-V switchgear for the South-East England Electricity Scheme, 1927 (London Area), and the supply, delivery and erection of 132,000-V transformers, and 132,000-V outdoor switchgear for the North-West England and North Wales Electricity Scheme. (January 18th.)

LONDON COUNTY COUNCIL.—February 4th. Wiring and fittings for electric lighting, heating and cooking in 86 tenements on Ossulston Estate. H.p. and l.p. cables, core re-actors, control battery, &c., for Greenwich power station. (January 18th.)

February 7th. Wiring and fittings for electric lighting at the Coroner's Court, Bethnal Green, and the Weights and Measures Office and Coroner's Court, Clapham (about 80 wiring points). (January 25th.)

METROPOLITAN ASYLUMS BOARD.—February 20th. Installation of electric lighting at Southwark Casual Ward. (See this issue.)

Lough Derg, Pettigo (Co. Donegal).—February 14th. Supply, delivery, and erection of two 10-kW heavy oil engine generating sets, storage battery, and switchboard. (January 18th.)

Lourenco Marques.—March 19th. Port and Railways Board. 50-kVA Diesel-driven generating set and an electrically-driven water pumping set. (B.X. 5050).*

Manchester.—February 5th. Board of Guardians. Supply of portable X-ray plant complete, for the Crumpsall Institution, Crescent Road, Crumpsall. Mr. F. W. Greenhalgh, clerk to Board of Guardians, Union Offices, All Saints, Manchester.

February 12th. Tramways Committee. General stores, including cable, bell wire, conduit tubing, switches, bells, cells, insulating material, &c. Schedules from the general manager, Corporation Tramways, 55, Piccadilly, Manchester.

Newton Abbot.—February 28th. Board of Guardians. Installation of electric lighting at the Institution, Newton Abbot. (See this issue.)

Newmilns (Ayrshire).—February 9th. Town Council. Electrical wiring in connection with the Council's housing scheme. Specifications from the burgh surveyor.

New Zealand.—WELLINGTON.—March 12th. Posts and Telegraph Department. Switchboard cords. (B.X. 5017.)*

April 9th. Public Works Department. Induction voltage regulators for Lake Coleridge scheme. (B.X. 5018.)*

DUNEDIN.—March 20th. Tramways Department. Tramway equipment. (A.X. 7441.)*

Northern Ireland.—BELFAST.—February 9th. L.M. & S. Railway. Northern Counties Committee (Ireland). Stores required during year ended February 28th, 1930, including telegraph ironwork, wire, electric lamps, porous pots, &c. Form of tender (6d. each) from Mr. F. J. Martin, stores superintendent, York Road Station, Belfast.

Portsmouth.—February 6th. Tramways Committee. Insulating materials, lamps, motor windings, overhead line materials, &c. (January 18th.)

Sheffield.—February 14th. Electricity Supply Department. Turbo-alternator, condensing plant, evaporating and steam preheating plant, water-tube boilers, chimneys, superheaters, stokers, or pulverised fuel firing equipment, economisers, &c., wagon tippers, conveyors and elevators, cooling towers, electrically and hand-operated travelling cranes. (January 11th.)

South Africa.—JOHANNESBURG.—February 14th. Town Council. Two 1,080-kVA transformers. (B.X. 5005.)*

CAPE TOWN.—March 15th. City Council. Metal-clad switchgear. (B.X. 5004.)*

PRETORIA.—March 28th. Posts and Telegraphs Department. Telephone switchboard cords. (B.X. 5048.)*

Staines.—February 9th. Board of Guardians. An additional 168 lighting points, including cables, at the Institution, London Road, Ashford, Middlesex. Specifications from Mr. J. H. Tyars, architect, 28, Victoria Street, Westminster, London, S.W.1.

Wandsworth.—February 2nd. Board of Guardians. Reorganisation of the engineering plant at the Tooting Hospital. (January 25th.)

West Ham.—February 18th. Education Committee. Installation of electric lighting at South Hallsville new school, Agate Street, Tidal Basin. (January 25th.)

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Birmingham.—Education Committee. Accepted :—
Electric lighting installations.—(£317), Reynolds & Bradwell; (£143), Baxter & Impey.

Brighton.—The Corporation General Purposes Committee has considered designs and prices for the electrical fittings for the interior and exterior of the Aquarium building, and recommends that the tender of the General Electric Co., Ltd., be accepted, at £1,340, for the internal fittings and £1,270 for the external fittings, and that Messrs. Pinching & Walton (who are the wiring contractors) carry out the work of the general fittings at an estimated cost of £400, making a total of £3,010.

Cowdenbeath, Fife.—Accepted :—
Electrical work in connection with the additions at the R.C. School.—Scott & Co. (Dunfermline).

Glasgow.—Tramways Committee. Recommended :—
Special track work.—Edgar Allen & Co., Ltd., Titan Trackwork Co., Ltd., and Hadfields, Ltd.
Electricity Committee. Recommended :—
12-kVA portable a.c. testing equipment (£168); seven 50-kVA transformers (£409).—Ferranti, Ltd.
50-h.p. motor (£143).—Alex. Stephen & Sons, Ltd.
50 large size electric cookers (£775).—Falkirk Iron Co.
Bases (76s. each), McCallum & Hope, Ltd.; steel poles (95s. each), Bromford Tube Co., Ltd.
Housing Committee. Recommended :—
Electrical installation at 510 houses on the Scotstoun Estate (£2,361).—A. Robertson.
Electrical installation at 366 houses on the Gairbraid Estate (£1,619).—D. Henderson.

Ilford.—Electricity Committee. Accepted :—
Cable (£1,060).—Union Cable Co., Ltd.

London. — POPLAR. — Electricity Committee. Recommended :—
Supply of economiser plant (£1,086).—Green Economiser Co.

LONDON COUNTY COUNCIL.—Main Drainage Committee. Electrically driven sewage plant at Abbey Mills pumping station. Installation of four pumping sets, with an option exercisable by the Council at any time prior to the taking over of the first four sets to purchase four additional pumping sets at the prices specified.

	First four sets. (1) £	Second four sets. (2) £	Total for eight sets. (3) £
W. H. ALLEN, SONS & Co., LTD. (Accepted)	36,677	23,985	60,662
Lilleshall Co., Ltd.	36,780	24,110	60,890
Gwynne's Pumps, Ltd.	38,305	24,914	63,219
Metropolitan-Vickers Electrical Co., Ltd.	38,640	25,850	64,490
English Electric Co., Ltd.	39,800	25,800	65,600
Worthington-Simpson, Ltd.	39,800	25,800	65,600
Vickers-Armstrong, Ltd.	36,500	35,300	71,800

The chief engineer's estimates comparable with the tenders were (1) £49,000, (2) £26,000, and (3) £75,000.

The committee has agreed to the sub-letting of the manufacture of articles required in connection with the contract as follows :—

(1) Motors, Crompton-Parkinson, Ltd.; (2) switchgear, Metropolitan-Vickers Electrical Co., Ltd.; (3) liquid starters, Erskine, Heap & Co., Ltd.; (4) automatic starters, Allen, West and Co., Ltd.; (5) sluice valves, Glenfield & Kennedy; (6) Venturi meter and recorder, British Pitometer Co., Ltd., or George Kent, Ltd., as may be required by the Council; (7) recording gauges and level indicator, Bristol & Co., Ltd.; (8) hydraulic pump, Joseph Evans, Ltd.; (9) pipework, Stanton Ironworks, Ltd., or other firm to be approved by the Council; and (10) electric cables, W. T. Henley's Telegraph Works Co., Ltd., or other firm to be approved by the Council.

Thornaby-on-Tees.—Town Council. Accepted :—
Wiring the library for electric light.—T. B. Watson and Son, Ltd.

Forthcoming Events.

Royal Society of Arts.—Monday, February 4th. John Street, Adelphi, W.C. 8 p.m. "The Treatment of Coal." Mr. C. H. Lander.

Association of Supervising Electricians.—Tuesday, February 5th. Junior Institution of Engineers, 39, Victoria Street, S.W. 6.30 p.m. "Beam Wireless." Lt.-Col. A. G. Lee.

Electrical Society of Glasgow.—Tuesday, February 5th. Reid's Smoke Room, Glasgow. 7.30 p.m. "Consumer, Contractor, and Supply Engineer." Mr. W. D. Brassington.

Royal Institution of Great Britain.—Tuesday, February 5th. Albemarle Street, W.1. Meeting to consider proposal to celebrate the electric discoveries of Faraday.

Thursday, February 7th. 21, Albemarle Street, W. 5.15 p.m. "The Early History of X-Rays." Sir Wm. Bragg.

Institution of Electrical Engineers.—Thursday, February 7th. Hotel Cecil, Strand, W.C. 7 for 7.30 p.m. Annual dinner.

(Meter and Instrument Section).—Friday, February 1st. Institution, London, W.C. 7 p.m. "Recent Developments in Electricity Meters, with particular reference to those for special purposes." Mr. J. L. Carr.

(Wireless Section).—Wednesday, February 6th. Institution, London, W.C. 6 p.m. "The Development of the Oxide-Coated Filament." Messrs. B. Hodgson, L. S. Harley, and O. S. Pratt.

(Informal Meeting).—Monday, February 4th. Institution, London, W.C. 7 p.m. "Earthing and the Safety of the Public." Mr. W. R. Rawlings.

(North-Western Centre).—Tuesday, February 5th. Engineers' Club, Manchester. 7 p.m. "The Construction of the Grid Transmission System in Gt. Britain." Mr. Johnstone Wright and Mr. C. W. Marshall.

(Dundee Sub-Centre). — Tuesday, February 5th. Lamb's Restaurant, Reform Street, Dundee. 7.30 p.m. Discussion. "Earthed *versus* Insulated Systems."

(East Midland Sub-Centre).—Tuesday, February 5th. University College, Nottingham. 6.45 p.m. "Overhead Electric Lines." Mr. W. B. Woodhouse.

(London Students' Section).—Friday, February 8th. Institution, London, W.C. 6.15 p.m. "Electric Welding." Mr. H. H. Taylour.

(North-Western Students' Section).—Saturday, February 9th. University Women's Union, Manchester. 7-11 p.m. Dance.

(North-Eastern Centre, Students' Section).—Friday, February 8th. Armstrong College, Newcastle-on-Tyne. 7.15 p.m. Address by the Senior Chairman.

Physical Society.—Friday, February 8th. Imperial College of Science, South Kensington, S.W. 5 p.m. Ordinary meeting.

Engineering and Scientific Club, Wolverhampton.—Friday, February 8th. "Sound Waves and Musical Tones." Mr. L. Southerns.

British Electrical and Allied Industries Research Association.—Friday, February 8th. Savoy Hotel. Luncheon and annual general meeting.

Electrical Engineers' Ball, 1929.—Friday, February 8th. Hotel Cecil.

Institute of Wireless Technology.—Monday, February 11th. Engineers' Club, W. 7 p.m. "The Principles of Television." Mr. A. W. Thynne.

Notes.

Water-power in British Columbia.

Detailed plans for one of Western Canada's largest power plants were revealed at Victoria, B.C., recently, when the Hon. F. P. Burden, Minister of Lands, approved of an undertaking by the West Kootenay Power & Light Co. on the Pend Oreille River. This brought the programme of electrical development immediately before this Province up to a total of over 300,000 h.p. The announcement of details of the scheme shows that it will proceed immediately on a large scale. Between four and six million dollars will be spent to produce 80,000 h.p., all of which will be needed even before it is available, for the enormous business of the Kootenay Co. at the Trail smelter and for its other industrial customers. In an official order, Mr. Burden gives the company until November 25th to commence the actual construction of the plan. Before that time it must submit further plans and secure a water licence, which will allow it to divert 6,000 cubic feet of water per second from the river. The chief engineering feature of the project will be the construction of a dam 175 feet high to control the waters of the Pend Oreille. Legal complications in the way of the scheme, which were expected to delay it, have been removed. Under the programme as finally submitted to the Minister, it will not be necessary to secure the approval of the International Joint Commission on Boundary Waters, as had been anticipated, although the Pend Oreille crosses the boundary. The topography of the river, and the West Kootenay Company's plan for taking advantage of it, are unique. The river rises in American territory, crosses the boundary, and then immediately flows into the Kootenay River, and practically all the fall in the stream occurs during its short journey through British Columbia.

The Rôle of Surface Energy in Chemical Engineering.

Under this title Prof. W. E. Gibbs, D.Sc., M.I.Chem.E., will deliver a public address at the Royal Society of Arts, John Street, Adelphi, London, on Friday next, at 8 p.m. The paper will deal with surface tension; the properties of fine powders; dust explosions; lubrication; and other kindred subjects. The Chemical Engineering Group of the Society of Chemical Industry will welcome visitors at the meeting, and, if desired, confidential advance proofs will be sent to non-members on application.

The Largest Alternator.

The first piece of what will be the most powerful single-shaft single-unit electric generating machine in the world, which is being built at the Schenectady plant of the General Electric Co., U.S.A., for the East River generating station of the New York Edison Co., was to be delivered at the station on January 15th. The shipment consists of the two halves of the stator shell of a 160,000-kW turbo-generator, which will be the third of nine sets to be ultimately installed at the East River station. The shipment was to make eight carloads, and on reaching New York it was to be loaded on a barge and towed to East River. The armature when fully wound will weigh 375 tons. The building up of the armature and the winding will take about six months.

33,000-kVA Frequency Changer on Fire.

An unfortunate accident took place on January 19th in the Metropolitan-Vickers Co.'s Trafford Park works, to a large frequency changer. Whilst running at full speed on test, a short circuit in the pit under the machine set fire to a temporary wood air discharge duct; flames indrawn from the duct by fans at both ends of the machine then set fire to the stator windings, which were seriously damaged in the period of 5 minutes that elapsed before the rotor, weighing over 70 tons, could be brought to rest. On inspecting the damage, it was decided to completely rebuild the stator, using new laminations, new copper, and new insulation throughout; but, although the work is being pushed forward strenuously by everyone concerned, it is estimated that a delay of 7 weeks may occur. The set is notable as being easily the largest frequency changer yet built in this country. It is a reversible machine designed on the one side for 3 phase, 25 periods, 11,000 volts, and on the other side for 3 phase, 50 periods, 6,600 volts. The normal rating is 33,000 kVA at 500 r.p.m., with a momentary overload capacity of 100 per cent. The set is being built to the order of the London Power Company for the Deptford West generating station.

Educational.

THE POLYTECHNIC.—The School of Electrical Engineering announces a special course of lectures on "Picture Telegraphy" by Mr. E. S. Ritter, D.F.H., M.I.E.E. (of the Post Office Engineering Research Section), between 5 and 6 p.m. on the following Wednesdays:—January 30th, February 6th, 13th, 20th, and 27th, March 13th, 20th, and 27th. The fee for the course is 7s. 6d.

The Use of Coal.

In the course of a paper on "The Rational Utilisation of Coal," read recently before the North-East Coast Institution of Engineers and Shipbuilders, Mr. W. J. Drummond said that one distinct advantage with plant designed to burn pulverised coal had over stoker-fired plant was the wide range of coal it was able to utilise, and the consequent advantages in price which buying coal from different sources might offer. There were many points which required further attention; among them probably the more important were:—

(*a*) The high cost of grinding, both from the point of view of power and replacements. The wear on a coal-pulverising plant was almost unbelievable to those who had no experience of it.

(*b*) Drying equipment. Most, if not all, plant was severely limited by the moisture content of the coal they would handle, particularly if it were fine coal.

(*c*) Dust emission, from the stacks.

It was frequently urged that the use of pulverised coal enabled all sorts of material with a high ash content to be burnt efficiently; while, from the technical point of view, that was correct, it was seldom economical to do so unless the material existed on the site, *e.g.*, at the collieries themselves. Fuel of high ash and consequently low calorific value could not bear any handling or transport charges. For pulverised fuel-fired plant in towns remote from the coal fields, coal cleaned by the pure gravity separation method should be ideal. Such a fuel would be all below, say, 3/16 in.; its ash content would be two to three per cent., free moisture five per cent., and calorific value equal to large coal. The grinding costs of such fuel would be the least possible because of the complete absence of anything except coal, and the dust discharge from the chimney would to all intents and purposes be eliminated.

There already existed in coal as mined quite a considerable amount, varying probably from 2 per cent. to 8 per cent. of the gross, which was ready for dust firing without further treatment. It was not an easy problem to separate it, and to make full use of it when separated would necessitate the general adoption of special wagons for its transport. The advantage of being able to buy pulverised coal would be very great to small consumers, and the natural dust was a valuable product because it had no preparation costs to bear.

Turning to the question of competition between coal and oil as alternative fuels for power production purposes, the author said that the cost of a therm in terms of oil was not

less than 2½ times that in terms of coal in England. Coal was in general more readily obtainable than oil, and the risk of accidental fire or explosion was much greater with oil than with coal. Moreover, coal could be more easily and cheaply stored than oil.

Appointments Vacant.

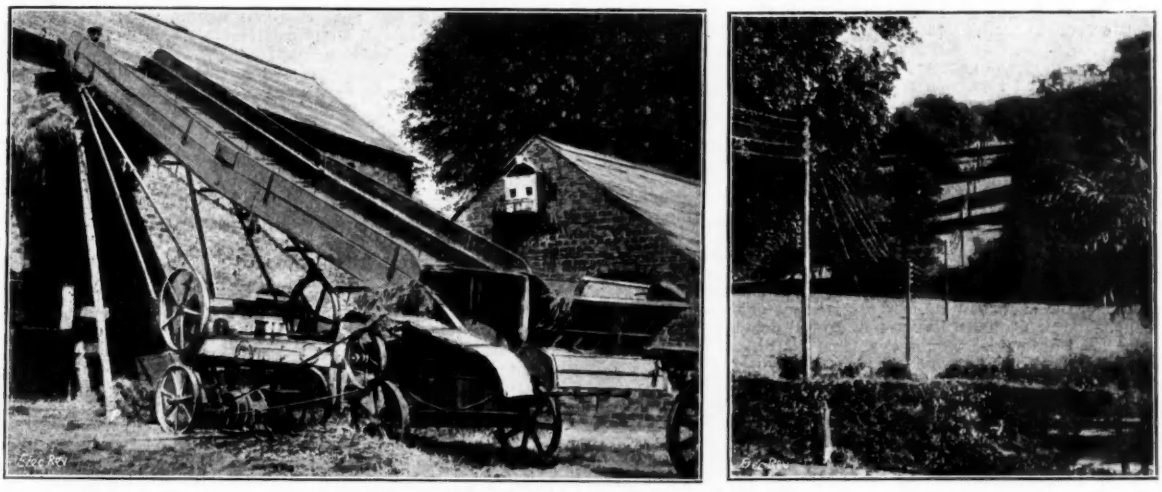
Electrical engineer at the City Road Institution for the Holborn Union. Professorship of Electrical Engineering at the College of Engineering, Guindy, Madras (Rs.1,000 a month). Assistant engineer (Rs.650 to Rs.750 per month) for the Government of Irak Posts and Telegraph Department. Sub-station attendant for the Colchester Corporation Electricity Department. Clerk (£180) for the Borough of Colne Electricity Department. (See our advertisement pages to-day.)

Lecture.

On Tuesday, January 22nd, Mr. Donald Smeaton Munro, chairman of the Scottish Centre of the I.E.E., read a paper on "Fire Hazards of Wiring" to the "Insurance Students' Circle," at Edinburgh. The meeting was largely attended, and the lecture was illustrated with practical experimental demonstrations particularly designed to show how the lack of continuity and defective earthing arrangements may cause outbreak of fire.

Rural Electrification Kinema Film.

Speaking after the exhibition of a kinema film designed to illustrate the benefits to be derived from the use of electricity in rural life and industries, Sir John Gatti said: "We do not pretend that we are going to make the farmer contented—that would be beyond the limits even of the most ingenious—but we hope we can show that electricity is a new factor in the life of the nation which the agricultural population might well hope to share, and that we are bringing to their doors the means of lessening labour which will help them towards a more prosperous era." The film was produced by the British Electrical Development Association, of which Sir John is president, and it was shown at the Plaza Theatre, London. Amongst those present were the Minister of Agriculture (Mr. W. Guinness) and the Minister of Transport (Col. W. Ashley). The accompanying illustrations are views from the film.



Examples of the Rural Application of Electricity.

The Swan Jubilee.

On January 17th Mr. E. S. Evans, district engineer of the North-East Coast Lighting Service Bureau, delivered a lecture at Sunderland on the Swan Jubilee, in the Subscription Library—the same building where Sir Joseph Swan gave his first Sunderland lecture on his lamp on January 17th, 1879. A member of the audience, Mr. Herbert Corder, was present also at the lecture given by Swan. It was pointed out by Mr. Charlton Deas, curator of the Museum, that Sunderland possessed no historical exhibits to commemorate the memory of Sir Joseph Swan, and an appeal has been made to possessors of his early lamps, either to give or lend on long loan an exhibit to the Sunderland Museum.

B.E.S.A. Publication.

The British Engineering Standards Association has just issued a revision of the B.S.S. for Tungsten-Filament Electric Lamps (No. 161-1928). The chief features of the revision are the reduction in the tolerances allowed on the light centre lengths, and, for lamps up to 100 watts, the light centre lengths themselves have been reduced. The overall length of the lamp and the maximum neck diameter, together with the distance from the contact plate of the cap at which the measurement of the neck diameter is to be made, are also given. The light output of lamps and efficiency are now given in terms of lumens only, except that in addition to the lumens output the nominal mean spherical candle power output is given. In former editions only maximum diameters of gasfilled lamps were given; in the revision the actual diameters (with tolerances) are specified for all sizes up to 100 watts. A change has been made with regard to the rating of vacuum traction lamps (series burning), the amperes at rated voltage being now adopted as a standard in place of volts at rated current. Copies of the specification, No. 161-1928, may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria Street, London, S.W.1, price 2s. 3d., post free.

The Radio Valve Equivalent Network.

In a paper recently published in the I.E.E. *Journal*, Mr. F. M. Colebrook, B.Sc., of the National Physical Laboratory, analyses the variation with the resultant anode-circuit load of the input impedance and voltage magnification factor of a triode valve. A new mode of presentation is adopted which enables the total range of variation of these quantities to be represented as finite functions of a variable with a limited range of variation. The most important conclusion is that at very high radio frequencies the voltage magnification factor may appreciably exceed the voltage factor of the valve, this condition being reached for a finite pure inductive load. Under the same conditions, however, the shunt input impedance is very low. The most efficient means of associating a tuned circuit with a receiver of relatively low input impedance is considered in an appendix, but it is not suggested that the best value of coupling capacity should be calculated and used in the design of receiving systems, which would be impractic-able owing to the difficulty of obtaining the necessary data for the calculation; however, in certain cases it will be advantageous to substitute a variable coupling condenser for a fixed one, and determine the suitable adjustment by ear; it could then, if desired, be replaced again by a fixed condenser of about the right capacity. A further application is to experimental work on input impedance of amplifiers and valves; it might be of particular use in the determination of negative input resistances by determination of the critical capacity coupling. Further, by the deliberate production of a negative input shunt resistance by means of a suitable inductive load in the anode circuit, a variable input coupling capacity can be used as a means of reaction control. This work was carried out as part of the programme of the Apparatus Committee of the Radio Research Board.

Fatality.

An inquest was held at Cambois (Northumberland) on January 22nd on the body of George Hornsby (43), who received a fatal electric shock in Cambois coal mine on January 12th. William Goodall, a shifter, stated that as he approached the haulage chain he received electric shocks in his feet with the result that he stumbled over the coal conveyor pans, receiving another shock. Robert Elliott, in evidence, said that just before the accident happened Hornsby and he were changing the picks of the coal-cutting machine. Hornsby, who was pulling the haulage chain, shouted, and witness ran to his aid. "As soon as I put my hand on the machine I got a shock. I got hold of a piece of timber, which took away part of the shock, but I was knocked down and my feet got on the machine and stuck there." The cause of the accident was described by John William Dawson, the chief electrician, as arcing inside an adaptor box used for joining up lengths of cable. An examination had shown that a locking pin was missing from the machine and from another adaptor box. Replying to Mr. Horsley, H.M. Electrical Inspector of Mines, witness said that if all the locking pins had been securely screwed in there would have been a better earth and it would

have been more likely for the man to have escaped. The jury, in returning a verdict of "Accidental death," added a rider suggesting the more frequent inspection of colliery electrical equipment.

Nothing but the Truth.

At the Electrical Contractors' Association dinner last week, Mr. T. P. Wilmshurst told the following story, which is worthy of reproduction:—

An American lady whose father had been electrocuted at Sing-Sing was desirous of entering London Society. Of course inquiries were made as to her antecedents, and, in reply to a direct inquiry regarding her people, she averred that her father had occupied the chair of applied electricity at a large public institution in America.

Institution Notes.

Institution of Electrical Engineers.

The annual dinner of the North-Western Centre of the I.E.E. was held at the Midland Hotel, Manchester, on Wednesday, January 23rd, Mr. J. Harcourt Williams, chairman of the Centre, presiding. About 280 were present. Among the guests were the President of the Institution, Lt.-Col. K. Edgcumbe, R.E. (T.), Dr. S. L. Pearce, C.B.E., Dr. S. Z. de Ferranti, F.R.S., Mr. A. Page, Sir Benjamin Longbottom, Mr. P. F. Rowell (secretary, I.E.E.), and the speakers named below.

In proposing the toast of "The Cities and Trade of Manchester and Salford," Major-General Sir PHILIP A. M. NASH, K.C.M.G., C.B., said the Manchester district had always been the scene of great enterprise in the electrical industry, and Manchester had also been a pioneer in education, but it was the fate of many pioneers to be passed by others who profited by their example. Erected 25 years ago, the Manchester College of Technology achieved distinction, but had been surpassed by other institutions of a like nature, and he heard that it was to be extended; in making the extension, the authories should think far ahead and make adequate provision, so that Manchester might again lead in training young men who would keep the city in the forefront of the industrial world. Transportation facilities were not up to the standard which so important a city should maintain. There were five terminal stations in Manchester not connected with one another, the suburban railway service was not very good, and congestion of traffic in the streets caused delays. But he was sure local enterprise would overcome all difficulties and provide facilities which would enable the two cities to prosper and increase.

The Lord Mayor of Manchester, Lt.-Col. G. WESTCOTT, O.B.E., J.P., replying to the toast, said that when the electrical industry began, incompetent people rushed in, and there were still some people of that kind trying their hand at it. The function of a society such as the I.E.E. was to raise the standard and ensure efficient service for the supply of electricity in bulk or in detail. The industry offered great advantages and enormous opportunities; he hoped the members of the Institution would seize those opportunities on every occasion. In electrical development in this country, Manchester was second to none.

The toast of "The Institution of Electrical Engineers" was proposed by Mr. DOUGLAS MILLER, M.A., High Master of the Manchester Grammar School. He remarked that he hoped the work of electrical engineers would always be directed to the benefit of mankind and not to its destruction. The PRESIDENT, responding to the toast, said he regarded the Centres as the backbone of the Institution, and it was a privilege to visit them and make the acquaintance of members who could not come to London. It was very interesting to see that other institutions had followed the example and established Local Centres. In his presidential address he tried to show that the prosperity of any country was directly proportional to the amount of goods turned out per head of the population. In the curve which he plotted it was curious how exactly proportional the standard of living was to the productivity. But there was still a great tendency on all sides, chiefly among labour, to ignore the fact that in order to maintain a high standard of living, a high productivity was essential. There had been seven years of desperately bad trade, the only parallel to which was the period which followed the Napoleonic wars; then the depression was followed by tremendous developments in the use of steam and machinery, leading to the prosperity which marked the Victorian era. He was afraid they could not hope for such developments now. But still, in spite of the seven years' bad trade, the standard of living was much higher now than it was 50 years ago, and that was entirely due to the fact that a great deal more material was produced per individual. In order to get out of the present troubles, production should be increased. When a man knew there was a good deal of unemployment in the country it was very difficult to convince him that the remedy was to turn out more stuff; to find suitable arguments the matter had to be gone into very deeply, and then the man would not understand the arguments. But it was the fact, and everybody ought to get it into his mind: the only way to maintain the standard of living in this country was to increase the production.

The CHAIRMAN proposed the toast of "Our Guests," which was replied to by Mr. H. W. ARCHER; and Mr. A. B. MALLINSON proposed "The Chairman," Mr. WILLIAMS briefly responding. Afterwards a reunion followed, the opportunity of meeting old friends being very much appreciated.

FARADAY MEDAL.—At the January 24th ordinary meeting of the Institution, Capt. J. M. Donaldson, M.C., vice-president, who occupied the chair, in the absence of the president, Lieut.-Col. K. Edgcumbe, R.E. (T.A.), on a duty visit to Dublin, announced that the Council had that day made the eighth award of the Faraday Medal to Signor Guido Semenza (local hon. secretary for Italy). Signor Semenza delivered the fifteenth I.E.E. Kelvin Lecture (see ELEC. REV., October 31st, 1924).

Junior Institution of Engineers.

A paper on Michell bearings was read by Mr. J. F. Petree, A.M.I.Mech.E., before the Junior Institution on January 18th. The author remarked that this type of bearing now found application in machines of diverse types in some of which the special needs essential to its satisfactory working were not understood, some of these being in thrust assemblies without proper provision for oil circulation, and with insufficient oil capacity. Probably more than 90 per cent. of such troubles as were met with in the running of Michell bearings could be attributed to an insufficiency of oil, or dirty oil. The author said there was no truth in the assertion sometimes made that a forced lubrication pump was a necessary adjunct to a Michell bearing.

Iron and Steel Institute.

The annual meeting of the Institute will be held on Thursday and Friday, May 2nd and 3rd, at the Institution of Civil Engineers, London, when Professor Henry Louis, M.A., will assume office as the President. The autumn meeting will be held at Newcastle in the week commencing Monday, September 9th.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

We regret to learn that Mr. V. W. DALE, the business manager of the British Electrical Development Association, was taken ill at Christmas with influenza, but we are glad to know that he is improving in health. The influenza was followed by pneumonia and empyema, and an operation was necessary, but good progress is now being made. We wish Mr. Dale a speedy return to his normal health and activity.

Mr. FRANK BUCKLEY, general manager of the Bury Corporation Tramways, has been appointed general manager and engineer of the Norwich Tramways. He takes up his new duties at the end of February.

The chairmanship of the Bradford Corporation Electricity Committee, vacant through the resignation of Alderman Wilfred Turner owing to ill-health, has been filled by Alderman J. W. LONGLEY, deputy chairman since 1910 (the period of Mr. Turner's chairmanship), except for one year when Ald. Longley took the chair owing to Mr. Turner being Deputy Lord Mayor. Ald. Longley is a consulting electrical and mechanical engineer, and he has taken a very important part, in conjunction with Ald. Turner and the city electrical engineer (Mr. Thos. Roles), in the development of the Bradford undertaking and in the preparations for the big extensions now in progress at the Valley Road generating station. Ald. Longley is succeeded in the Deputy-chairmanship by Councillor CHRIS. WATKIN.

Mr. E. W. UNWIN has arrived in London to act as export manager for Messrs. J. H. Connor & Son, Ltd., washing machine manufacturers, Ottawa. His address is, c/o The Canadian Chamber of Commerce in Great Britain, British Columbia House, 3, Regent Street, S.W.1.

At a recent meeting of the Chester Council it was decided to appoint an assistant to Mr. S. E. BRITTON, the city electrical engineer. It was stated at the Town Council meeting

last week that many replies were received to an advertisement, but none of the candidates was quite suitable. The Council, therefore, accepted a recommendation of the Electricity Committee to rescind the previous motion of the Council, and in lieu thereof decided to appoint a mains superintendent.

The Derby Tramways Committee on January 21st appointed Mr. P. W. BANCROFT as deputy tramway manager for a period of six months. At the end of that time the question of the managership will be finally decided.

The Ilford Corporation Electricity Committee recommends that the salary of Mr. H. KING, assistant commercial manager, be increased from £500 to £550 per annum.

The General Purposes Committee of the Bridlington Town Council on January 21st considered a recommendation by the Electricity Committee that the salary of the borough electrical engineer (Mr. BECKETT) should be increased from £640 to £705 per annum. It was decided to defer the matter until the end of the financial year.

A large number of readers will learn with interest, and regret, that Miss LANFEAR will no longer take part in the arrangements for the I.M.E.A. conventions, at which she has so long been a most popular figure. As will have been inferred from the advertisement which appeared in our last issue, Miss Lanfear has resigned the post of secretary to the Association, which she has occupied for nearly 10 years. We can only express our sincere regret, and our hope that she will in some other *rôle* continue to serve the industry as efficiently as hitherto.

The *Industrial Australian and Mining Standard* states that after returning from a visit of inquiry abroad, Mr. R. LIDDELOW, secretary of the State Electricity Commission of Victoria since its inception, was given the additional title of commercial manager. It has now been decided to appoint him as commercial manager, in order that he may devote himself to the commercial development of the Commission's affairs. The assistant secretary, Mr. W. J. PRICE, has been appointed as secretary. Mr. D. E. WILLIAMS, fuel sales manager, has been appointed electrical sales manager. The same contemporary also states that Mr. G. L. JUST, manager in Australia for the Edison Swan Electric Co., Ltd., has been elected president of the Electrical Federation (Victoria). The *Industrial Australian* further announces that Mr. W. J. MOUNTAIN has resigned the secretaryship of the Melbourne Electric Supply Co., Ltd., a position which he has held since the inception of the company more than 28 years ago. Mr. J. A. KENNEDY, the assistant secretary and chief accountant, has been appointed to the position.

On December 11th a goodly gathering of representatives of electrical interests in Sydney gave a dinner in honour of Sir HUGO HIRST, BART. Mr. A. Maughan, the chairman, proposed Sir Hugo's health, and Mr. H. Forbes-Mackay and Sir Arthur Cocks supported. In responding, Sir Hugo is credited by the *Industrial Australian* with the remark that "a perfect atmosphere of friendly goodwill subsists between competing manufacturers in England to-day," and he was delighted to gather that the same spirit was sedulously cultivated in Australia.

It is recommended that the Nelson Electricity and Tramways Department should be reorganised. Under the scheme, Mr. G. N. NAYLOR, manager of the tramways and 'buses and electrical engineer, would confine his attention to the electricity department, while Mr. WHALLEY, chief clerk to the tramways, would take charge of the transport section.

According to a Sydney paper, Mr. W. R. CAITHNESS, a director of the British General Electric Co., Ltd., left Sydney on December 18th on a business trip to England.

The Times states that the Swiss Federal Council has appointed M. H. J. BOULANGER, of Grenoble, director of the Telegraphic and Wireless Service of the French Telegraph Administration, vice-director of the International Bureau of Telegraphs, in the place of M. Poulaine, recently deceased.

Mr. WILLIAM FORBES has resigned the post of manager of the Aberdeen Corporation Tramways on his appointment to a similar post under the Cardiff Corporation. A sub-committee of the Tramways Committee is considering the duties of the post and the question of a successor.

Mr. JAMES W. MCKAY, general secretary of the Electrical Wholesalers' Federation, Ltd., is prospective Liberal candidate for the city of Coventry.

Mr. D. A. S. PORTEOUS, A.C.G.I., A.M.I.E.E., formerly and for the past twelve years with Messrs. Johnson & Phillips, Ltd., has been appointed works manager to the Enfield Cable Works, Ltd., as from the beginning of 1929.

Obituary.—MR. SYDNEY MORSE.—We regret to record the death, which occurred on Sunday last at his residence in Airlie Gardens, Campden Hill, London, W., of Mr. Sydney Morse, J.P., Associate I.E.E. He had been playing golf the day before his death. Mr. Morse, who was 74 years of age, was a solicitor by profession. He began his interest in electrical affairs in connection with the late Mr. W. T. Henley and W. T. Henley's Telegraph Works Co., Ltd. From the year 1884 onwards for many years he played a prominent part in connection with electric lighting matters. He acted in the securing of many Provisional Orders, and for many electric lighting, tramway, and other companies. He was most prominent in association with such interests on their legal side, but he was also to the fore in opposition to municipal trading, was a member of the Electrical Trades Section of the London Chamber of Commerce for several years, and served on the Council of the Institution of Electrical Engineers.

Will.—Mr. FRANK SCHOFIELD, commercial manager of the Stalybridge, Hyde, Dukinfield, and Mossley Joint Tramways and Electricity Board, left £1,867.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Sterno Manufacturing Co., Ltd.—Private company. Registered January 19th. Capital, £10,000 in £1 shares. Objects: To acquire the leasehold property at 19, City Road, E.C., and the business of gramophone and wireless manufacturers and dealers carried on by the British Homophone Co., Ltd., together with the trade mark "Sterno." The subscribers (each with one share) are:—M. M. Innes, Oakleigh, 107, Park Road, Chiswick, W.4, clerk; W. C. Mitchell, 14, York Road, Walthamstow, E.17, clerk. Solicitors: Cohn, Seligman & Bax, 52, New Broad Street, E.C.2.

George Ellison, Ltd.—Registered as a private company, January 20th. Capital: £125,000 in £1 shares (30,000 preference and 95,000 ordinary). The preference shares confer the right to a fixed cumulative preferential dividend of 7 per cent., and the right to an extra 1 per cent. for every 1 per cent. dividend on the ordinary shares in excess of 10 per cent., but not exceeding for any year an extra 3 per cent. on the preference shares. Objects: To acquire the business of an engineer and maker of electric control switchgear carried on by G. Ellison at Perry Barr, Birmingham, together with the branches and subsidiary businesses belonging thereto. The subscribers (each with one share) are: T. G. Ellison, Flint Green Works, Acocks Green, Birmingham, engineer; G. Ellison, 14, Brueton Avenue, Solihull, engineer. G. Ellison is governing director at a salary of £3,000 per annum until he resigns or dies or ceases to hold half the ordinary shares allotted to him under the purchase agreement. Registered office: Wellhead Lane, Perry Barr, Birmingham.

South Essex Supply Co., Ltd.—Private company. Registered January 24th. Capital, £500 in £1 shares. Objects: To carry on the business of electrical, mechanical, and general engineers, tinplate workers, sign makers, &c. The directors are: E. J. Wreford, J. S. Wreford, and L. Summers, all of "Southcott," Squirrels Heath Road, Harold Wood, Essex. Registered office: 30, London Road, Romford, Essex.

Midland Radio Service, Ltd.—Private company. Registered January 19th. Capital, £5,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in apparatus for receiving, transmitting, reproducing or recording sounds, pictures, &c., and electrical, magnetic, chemical, optical, and scientific apparatus, &c. The subscribers (each with one share) are: H. C. Duffell, 7, Farquhar Road, Edgbaston, Birmingham, insurance official; H. F. Duffell, 7, Farquhar Road, Edgbaston, Birmingham, electrical engineer. Registered office: 7, Farquhar Road, Edgbaston, Birmingham.

Nye & Menzies, Ltd.—Private company. Registered January 21st. Capital, £1,000 in £1 shares. Objects: To carry on the business of railway and general engineers, agents for, brokers and factors of, dealers in and manufacturers of railway and general engineering equipment, tramways, motors, signalling apparatus, electrical and wireless apparatus, &c. The subscribers (each with one share) are:—Joan Peachey, 9,

Hetley House, Hetley Road, W.12, private secretary; A. D. Poulter, 59, Rectory Road, Chelmsford, solicitor's clerk. The permanent directors are: C. E. K. Menzies and O. B. Marks. The other first directors are to be appointed by the subscribers. Registered office: 62, New Broad Street, E.C.2.

Meteor Electric Lamp Co., Ltd.—Private company. Registered January 21st. Capital, £500 in £1 shares. Objects: To carry on the business of commission agents, agents for the sale or purchase of machinery, manufacturers of and dealers in electric lamps, irons and kettles, machines, batteries, and all other electrical appliances, &c. The directors are:—L. J. Restall, 19, Fairmount Road, S.W.2; A. R. Ingersoll, 10, Lewisham Park, S.E.13. Registered office: 33-34, Sicilian House, Sicilian Avenue, W.C.1.

Harmony, Ltd.—Private company. Registered January 21st. Capital, £500 in £1 shares. Objects: To carry on the business of manufacturers of and wholesale or retail dealers in wireless receivers and instruments, drawn wire electric cables, electric lamps and parts, articles, and things used in connection with electrical, telegraphic, telephonic, and radio appliances, &c. The subscribers (each with one share) are:—Eva Ayres, 44, Beecroft Road, S.E.4, cashier; H. J. Ellery, 20, Maude Terrace, E.17, clerk. Registered office: 66, Newman Street, W.1.

Cryptocode Machine Syndicate, Ltd.—Private company. Registered January 25th. Capital, £10,000 in 5,000 preference shares of £1 each and 25,000 ordinary shares of 4s. each. Objects:—To carry on the business of manufacturers of and dealers in automatic, electrical, mechanical or other apparatus, machines, or other means used in connection with codes, codification, other secret forms of communication or similar processes, &c. The directors are:—E. W. Rollings, "Roseneath," Burges Road, Thorpe Bay, Essex; E. Shore, "Breakspears," Studland Road, Hanwell, W.7. Secretary: H. W. Bowen. Solicitors: S. Sebba, 7-8, Great Winchester Street, E.C.

Official Returns of Electrical Companies.

Sun Electrical Co., Ltd.—Capital, £100,000 in 50,000 ordinary, 20,000 preference, and 30,000 preferred ordinary shares of £1 each. Return dated November 26th, 1928. 27,112 ordinary, 17,391 preference, and 27,677 preferred ordinary shares taken up. £72,180 paid. Mortgages and charges, £22,760. Return of allotments, made up to December 14th, 1928, shows a further 90 preferred ordinary and 600 ordinary shares allotted, payable in cash and fully called up.

Lustrolux, Ltd.—Capital, £25,000 in £1 shares. Return dated June 12th (filed December 13th), 1928. 9,002 shares taken up. £9,002 paid. Mortgages and charges: £6,000.

Hallwood & Ackroyd, Ltd.—Capital, £25,000 in 3,200 preference and 1,800 deferred shares of £5 each. Return dated December 1st, 1928. All shares taken up. £15,500 paid on 3,100 preference shares, £9,500 considered as paid on 100 preference and 1,800 deferred shares. Mortgages and charges: £50,000 sealed debentures.

B.H.M., Ltd.—Capital, £5,250 in 5,000 preference shares of £1 each and 5,000 ordinary shares of 1s. each. Return dated October 2nd, 1928. 3,751 preference and 2,850 ordinary shares taken up. £3,086 paid on 3,001 preference and 1,700 ordinary shares, £807 10s. considered as paid on 750 preference and 1,150 ordinary shares. Mortgages and charges, nil.

E. A. Langrish & Co., Ltd.—Capital, £15,000 in 7,500 preference and 7,500 ordinary shares of £1 each. Return dated November 8th, 1928. 5,800 ordinary and 5,965 preference shares taken up. £11,234 19s. 11d. paid, leaving £530 0s. 1d. in arrears. Mortgages and charges, nil.

Commercial Telephone & Electrical Co., Ltd.—C. J. Hocking, builder, 35, Great Queen Street, Holborn, W.C., was appointed receiver on January 10th, 1929, under powers contained in debentures dated April 30th, 1924. J. H. Rook, solicitor, ceased to act as receiver and manager for the debenture holder on the above date.

Hackbridge Cable Co., Ltd.—Satisfaction in full on January 17th, 1929, of debentures dated January 12th, 1921, securing £40,000.

Particulars filed of £50,000 debentures authorised on January 17th, 1929, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Corwen Electric Light Co., Ltd.—Capital, £2,000 in £1 shares. Return dated November 6th, 1928. 1,610 shares taken up. £1,610 paid. Mortgages and charges nil.

Metalite Co., Ltd.—Capital, £100 in £1 shares. Return dated December 10th, 1928. All shares taken up. £100 paid. Mortgages and charges nil.

E. & W. Shepherdson, Ltd.—Debenture dated January 9th, 1929, to secure £350, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: W. Shepherdson, "Sunninghill," Longlands Lane, Morecambe.

Abbey Cables, Ltd.—Debenture dated January 9th, 1929, to secure £1,000, charged on the company's property, including uncalled capital. Holder: S. G. W. Norton, Norton House, Peaks Hill, Purley.

Colston Electrical Co., Ltd.—Debenture dated January 17th, 1929, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: W. J. F. Dutson, Grove Lodge, Parry's Lane, Stoke Bishop, Bristol.

J. C. White & Co., Ltd.—Debenture charged on the company's undertaking and property, including uncalled capital, dated December 31st, 1928, to secure all moneys due or to become due from the company to the Union Bank of Manchester, Ltd.

W. Mackie & Co., Ltd.—Capital, £12,000 in £1 shares. Return dated November 15th, 1928. 7,500 shares taken up. £3,155 paid. £4,345 considered as paid. Mortgages and charges nil.

Electric Supply Co. of Victoria, Ltd.—Capital, £325,000 in 175,000 preference and 150,000 ordinary shares of £1 each. Return dated November 29th, 1928. 175,000 preference and 125,000 ordinary shares taken up. £50,007 paid. £249,993 considered as paid. Mortgages and charges nil.

City Notes.

Prospectuses.

Vorarlberger Illwerke A.G. (*V.I.W.*).—Last week this company offered for public subscription £2,000,000 of 6 per cent. 30-year sterling bearer bonds at £92 per cent. The prospectus stated that the company was incorporated in Austria for the production of electricity, principally by water power. A third of the power produced is taken by agreement by each of the following concerns: Bezirksverband Oberschwäbische Elektrizitätswerke (O.E.W.") and the Grosskraftwerk Württemberg A.G. ("Growag"). The remaining third is at the option of the State of Vorarlberg. The Rheinisch-Westfälisches Elektrizitätswerk A.G. ("R.W.E.") has undertaken the rights and liabilities of the "Growag," and the three companies mentioned have agreed that until the whole of the bonds have been repaid, the amount paid by them shall be sufficient to cover the working expenses of the V.I.W. and the service of the bonds. The present capital of the V.I.W. is 20 million schilling, and an increase to 35 million sch. has been authorised. The proceeds of the loan are to be applied in the completion of the Vermuntwerk and Obervermuntwerk stations and other works; the annual output of these stations will be 150 million kWh and 35 million kWh, respectively. Further schemes which have been prepared will raise the company's annual output to 500 million kWh.

Glare-Visor (*Parent*) *Co., Ltd.*—Last week this company made an issue of 1,250,000 shares of 2s. each, representing half of its authorised capital. The company was recently formed to acquire sole and exclusive rights in an anti-dazzle screen, the "Correcta" dipping and swivelling headlight system and "Balkite" power units for charging purposes, &c. The chairman of the company is Sir Robert D. Moncreiffe, Bart. (chairman, Correcta Light, Ltd.), and the registered office is at 16, St. Helen's Place, E.C.3.

Central Public Service Corporation.

This American company last week published, for information only, in compliance with Stock Exchange Regulations, particulars of its constitution and objects. Its authorised share capital is $2,000,000, of which $538,605 has been issued, and it has a funded debt of $10,077,000. The primary objects of the company are those of a holding company, but it also has power to carry on electricity, gas and other public service undertakings. Its subsidiaries, operating in the United States and Eastern Canada, own 96,866 h.p. of electrical plant (27,536 h.p. hydro-electric), 1,266 miles of transmission lines, and 224 miles of electric railway. The consolidated net earnings of the company and its subsidiaries in the year ended October 31st last were $5,674,004, and a balance of $2,182,989 remained after meeting bond interest, &c., which was sufficient to cover more than three times the dividends on the outstanding preferred stock.

Dublin United Tramways Co., Ltd.

From the profits of the past year the directors propose to place £50,000 to track renewals, £15,000 to the mortgage debenture redemption fund, and £7,000 to overhead lines and cables. A final dividend at the rate of 5 per cent. per annum is recommended, making 4 per cent. for the year (against 4½ per cent.), leaving £13,785 to be carried forward.

Vulcanite, Ltd.

The net profit for the year ended October 31st, 1928, was £6,024 (against £1,157 in 1926-27). A dividend of 6 per cent. (against *nil*) is recommended; £2,000 is to be placed to depreciation and a similar amount to the preference share dividend reserve, leaving £333 to be carried forward. The Wigan property has been enlarged and is now producing a new product for which there has been a considerable demand. The liquidation of the French subsidiary is nearing completion.

Aldershot Gas, Water and District Lighting Co., Ltd.

The annual meeting of the company was held on January 30th. The chairman, after reviewing the progress of the gas and water departments, said that the electricity department showed an increase of sales in the "B" area of 18.1 per cent. over 1927. He gave a list showing the advance in the use of various electrical appliances. The Hindhead undertaking was absorbed by the company in December last; that concern's accounts were not yet complete, but a full statement of the assets and liabilities would appear in the 1929 accounts. Three additional Special Orders had been applied for, and a public inquiry had been held by the Electricity Commissioners; the result of this was not yet available. Since Michaelmas, 1927, the price of electricity for lighting had been reduced by 0.8d. per kWh, and it was hoped to make a further reduction from Midsummer. The bulk of the capital expended during the year (£7,818) was in connection with the electricity undertaking. It was hoped to commence the erection of new showrooms at Fleet and Hindhead during the current year. The report and accounts were adopted.

International Light and Power Co.

There was a balance of £302,350 to the credit of profit and loss account for the period July 1st, 1927, to March 3rd, 1928, but after providing for debenture interest, &c., administrative expenses, and loss on sale of investments, there was a deficit of $3,769,306. A credit balance is brought forward, and other amounts totalling $965,233 are credited, reducing the deficit to be carried forward to $2,804,072.

Official Notices re Companies.

The names of the undermentioned companies will be struck off the Register at the expiration of three months unless cause is shown to the contrary:—

Barford Electric Supply Co., Ltd.
Direct Electrical Co., Ltd.
Electric Light & Power Contracts Finance Corporation, Ltd.
South Midlands and Berkshire Electric Light & Power Co., Ltd.
Warwickshire and South Midland Electricity Supply Corporation, Ltd.

Norwich Electric Tramways Co.

In compliance with Stock Exchange requirements, the company published this week, for information only, particulars of its constitution, &c. It was incorporated by Special Act in 1897, and under this and two later Acts operates 16½ miles of tramways, which are purchasable by the local authorities in 1932 or any seventh year thereafter; it also has motor-omnibus services. The authorised capital is £300,000 in £10 shares, of which £264,000 has been issued, fully paid. The company has issued £66,000 of 4 per cent. mortgage bonds, redeemable at par upon the purchase of the undertaking. When the remainder of the unissued capital is raised, the company is empowered to borrow a further £12,000 on mortgage.

Brazilian Traction, Light and Power Co., Ltd.

This week the company announced the completion of the purchase of nearly all the ordinary shares of the City of Santos Improvements Co., Ltd. The business of this company includes the supply of electric light and power in the city and the running of tramways. The acquisition calls for an expenditure of about $14,000,000, and the rapid expansion of the company's other undertakings necessitates further capital. The projected developments include the installation of a 40,000-h.p. set at the Parahyba (Rio) plant and one of probably 60,000 h.p. at the Serra (Sao Paulo) plant. The board has accordingly decided to offer to the holders of the company's ordinary shares additional ordinary shares of no par value on the basis of one share for each seven shares held, at the price of $40 per share. At a recent meeting of the board a quarterly dividend of 50 cents per share was declared on the ordinary shares.

German Company.

At its meeting on January 21st the board of the *Allgemeine Elektricitäts Gesellschaft* decided to recommend a dividend of 8 per cent. out of the net profits, amounting to 16½ million marks. It was stated that the turnover of all the companies affiliated to the A.E.G. totalled over half a milliard marks, while the orders at present in the hands of the company were estimated to be worth 385 million marks.—*Reuter.*

Stock Exchange Notice.

Dealings in the following have been allowed by the Committee of the Stock Exchange under Rule 159:—

Baird International Television.—25,000 "A" shares of 5s. each, fully paid, Nos. 1,025,001 to 1,050,000.

Stocks and Shares.

MONDAY EVENING.

STOCK Exchange markets again show strength in most departments. Investment takes the good stock which comes on offer: speculation is actively employed in the search for further fields which have not yet been discovered by the American gambler, and, not finding these, has to rest content with the stocks and shares at present available. One of the features of the past few business days has been a spurt in the prices of the Eastern cable stocks. Movements amongst cable equipment and electrical manufacturing shares are a little irregular. There is plenty of money for investment in the stock markets, there is a general willingness to use it, there is—in the third place—a steadily decreasing amount of stock or shares for purchase at anything that looks like a reasonable level. Some talk arose, early this week, of money becoming tighter within the near future, and this served to cast a slight shadow over the gilt-edged market.

"Dollar" Stocks.

Mention has been made on many occasions of the way in which the capital stock and shares in the American-Canadian utility companies have been rising. Prices have now reached such a level that they would seem to offer little further scope for appreciation. To take one example, Shawinigan Water common stock is up to 94; the company last paid 2 per cent. on the shares, so that the yield on the money at the present time is hardly more than 2¼ per cent. Nevertheless, the company is one of the best of its kind in the list, and its profits show annual expansion. Every now and then a new issue is made at a price which provides a handsome bonus to the proprietors. Anticipation of this policy being continued lends attraction to these shares at the present time. Otherwise, investors would hardly think of accepting so meagre a rate of interest on their money.

Brazilian Tractions, pursuing an erratic course, touched 79 and rallied to 81¼. The participating preference have moved up to 260. A rise of 9 points lifted Pennsylvania Water and Power to 95½. Consolidated Gas and Electric Light of Baltimore shares are almost equally higher on the week at 111¼. Mexico Tramways bonds rose a point to 60; the common shares advanced to 57½. Mexican Light and Power issues are unchanged. Pachuca Light and Power fives are better at 73. British Columbia "A" and "B" hardened to 59½ and 40¼, respectively. Hydro Electrics are 40. Winnipeg Electric 5 per cent. bonds firmed up to 91¼.

Artificial Values?

The statement is sometimes heard that present-day values in the Stock Exchange are largely artificial, the contention being based on the idea that dividend payments do not justify the existing quotations of shares not in dozens, but in hundreds, of different companies. How long the present state of affairs is going to last, or whether it will turn out to be the entry of a new régime in the world of finance, it will require a shrewd prophet to estimate. The demand for stock, especially of the more speculative order, comes largely from across the Atlantic, where the idea of values is certainly more blurred than it is over here. So long, however, as New York and Montreal set the pace by their insistent demand for industrials, irrespective of what dividends are paid, so long must prices continue to mount under the pressure of the buying orders which the Stock Exchanges receive in increasing quantities every week.

Home Railways.

The Metropolitan Railway Company declares its dividend on Thursday of this week, and anticipation looks for a possible 3½ to 4 per cent. for the year ended December 31st last. In the previous twelve months the company paid 3 per cent., but the traffics of last year were good enough to justify the expectation of an improvement. The results will be out before these notes appear. Meanwhile the price of the stock has remained at 67, while Districts are unchanged at 80. The feature amongst Home Rails is the strength of Underground Electrics, where the 6 per cent. incomes have spurted to 131, and the shares have had a jump of 28s. Optimists look for 8 per cent. on the latter. They will have to wait until February 7th before the company satisfies the doubts, which are at present bounded between 6 per cent., and the 8 per cent. just mentioned. London and Suburban Traction preference retain their strength at 13s., and London United Tramways debenture keeps about 61.

London Electricity Supply.

County of London Electric Supply ordinary have been in active demand, the provinces joining with London in purchases

which raised the price to 49s. 6d. This is a florin gain since a week ago, when the price had already put on nearly as much by comparison with the previous week.

Bournemouth and Poole also proved a lively market, the quotation remaining unchanged, on balance, at 68s. 6d. London shares, apart from Counties, have not moved. The report of the London and Home Counties Joint Electricity Authority, dealing with its members' conclusions upon the London Electricity Acts of 1925, was published last week. The report maintains that it is clearly the intention of the scheduled agreements to limit divisible and surplus profits in such a way as to encourage reduced prices to, and increased consumption by, all classes of electricity users, and to exhaust the revenue of a company by reducing charges for current, the provision of limited interest, dividend charges and reserve funds, &c. The report is applicable to the London electricity supply companies. Shareholders may think that the phrasing—"to exhaust the revenue of a company"—sounds drastic, if not callous, but the clause serves to emphasise the unlikelihood of more than 7 per cent. dividend, the statutory rate, being paid by the London companies which do not occupy any exceptional position. Kent Electric 4½ per cent. debenture is 5 points better at 85. In the list of provincial shares Midland Counties ordinary are a little better at 30s. 6d.

General Electrics Jump.

The manufacturing group show irregular movements. British Aluminium ordinary shares, after their very sharp spurt, have reacted a trifle, to 47s. 6d. The market seems to be puzzled by the previous rise, for no particular increase in the dividend is expected, and the return on the money at the present price of 47s. 6d. is no more than four guineas per cent. It is thought, therefore, that some other cause, yet to be explained, is responsible for the improvement. British Insulated have been a good market, putting on ¾ at 4 9/16. At this the yield on the money comes to £3 6s. per cent., on the basis of the 15 per cent. dividend at present being paid. General Electrics put on 6s. 3d. within the last half-hour of Monday afternoon, jumping to 3¼. The demand emanated from America. The 6½ per cent. preference are 1s. up at 24s. 6d. Prices of shares in the other members of this group are quiet. People who hold interests in such shares are looking for the companies to increase their earnings through the coming developments in the electricity supply, and in the cable-radio industries.

Seventy-five Points Up.

British Electric Traction deferred ordinary stock is 75 points higher on the week. The nominal price of 775 is probably well under the figure that a seller would obtain if he had a reasonable amount to offer. It is declared that the stock is worth at least 1,000 on its merits. There are buyers at 800 at the present time. This week the 8 per cent. preferred stock is up a point, which makes it 125. Another dramatic rise, though far less than B.E. Traction deferred, is in American Telephone and Telegraph, which has gained 17½ points at 225.

Breaking New Ground.

Those holders of United River Plate Telephones who accepted International Telephone and Telegraph stock in exchange for their shares have received a letter from the president of the latter company, giving them details of their new undertaking, with an evident desire to make the proprietors feel at home, as it were, with their acquisition. The idea is not entirely new to British companies, but it is sufficiently rare to make the practice worthy of remark. The too-general attitude of British boards of directors is to treat their fellow shareholders as being of no account unless proxies are required. Some directors would consider the International Telephone chairman's effort as being either superfluous or undignified, if not both. But the common-or-garden shareholder will probably appreciate such departure from the moss-grown paths of financial convention.

Cable Stocks.

The Eastern cable group is decidedly better, Eastern Telegraph ordinary being 5 points higher; Globes, Eastern Extensions and Westerns are 10s. to 15s. up. Attention is earnestly fixed upon what the companies—the Globe Telegraph and Trust excepted—will receive under the merger arrangements. It is said that everything is cut-and-dried in regard to the exchange of securities, the market anticipations in respect of which were repeated in last week's ELECTRICAL REVIEW, on page 164. A still more considerable gain is one of £3 in Indo-Europeans, where the price is up to 54½. The wireless section is also better. Marconis at 78s. 9d. and Marconi Marines at 72s. 6d. show improvements. The Marine Company is expected to publish excellent figures within the course of the next week or so. The dividend for last year, 12½ per cent., will certainly be exceeded by 2½ per cent., if not by more. Hopefulness looks for a bonus of some kind, either in the dividend or in the shape of new shares. Burndepts are keeping their rise.

The rubber share market is quietly firm. Iron and steel shares are a trifle uncertain. The excitement in Ever Ready and Everlite shares has subsided, at any rate for the time being.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1926.	Dividend. 1927.	Price Jan. 28, 1929.	Rise or fall.	Yield. p.c.
	£					
Bournemouth and Poole	1	14†	15	68/6	—	... ...
Brompton Ordinary	1	8⅜	8½	27/-	—	5 3 8
Charing Cross Ordinary	1	8½	8½	26/-	—	5 7 8
do. do. 4½% Pref. ...	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8⅞	8⅞	27/-	—	5 3 8
City of London	1	10	10	32/-	—	4 7 6
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	2	—	4 2 0
County of London	1	7½	7½	49/6	+2/-	3 3 0
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Edmundsons' 7% Pref.	1	7	7	25/-	—	5 12 0
Elec. Supply Corporation	1	11	11	56/3	—	3 18 3
Kensington Ordinary	1	8	8	26/6	—	5 5 8
Lancs. Light and Power	1	7½	7½	30/-	—	5 0 0
London Electric	1	8½	8½	26/-	—	5 7 8
Metropolitan	1	8	9	47/6	—	3 15 8
do 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	6	6½	30/6	+6d.	4 5 3
Mid. Elec. Power	1	—	15	9 3/32	—	... ...
Newcastle-on-Tyne Ordinary ...	1	5	6	27/-	—	4 9 0
do. 7% Pref. ...	1	7	7	26/6	—	5 5 8
Notting Hill 6% Pref.	10	6	6	10½	—	5 11 7
North Met. Elec. 6% Pref. ...	1	6	6	23/-	—	5 4 4
St. James' and Pall Mall	5	8	8	27/6	—	5 1 10
Scottish Power	1	8	8	33/-	—	4 17 0
South London	1	8½	8½	27/6	—	5 2 8
Urban Ordinary	1	7	7	40/9	—	... ...
Westminster Ordinary	1	8⅝	8⅝	27/-	—	5 3 8
Whitehall Elec. Invst. 7½% Pref....	1	7½	7½	24/3	—	6 3 8
Yorkshire Elec.	1	8	8	36/6	—	4 7 8

†4% of which was tax free.

HOME RAILS.

Central London Ord. Assented ...	Stock	4	4	78	—	5 9 7
Metropolitan	,,	3	3	67	—	4 9 7
do. District	,,	3½	4	80	—	5 0 0
Underground Electric	£1	1½	5	28/-	+1/-	3 11 5
do. do. Income ...	Bonds	6	6	131	+4	4 11 7

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	102½xd.	—	5 17 1
do. Def.	,,	1½	1½	25½xd.	—	5 17 8
Automatic Telephone	1	10	10	2⅛	+1/16	4 14 1
Eastern Extension	10	10	10	27½	+3/4	*3 13 6
Eastern Tel. Ord.	Stock	10	10	272½	+5	*3 13 6
Globe Tel. and T. Ord.	10	10	10	36	+½	*3 17 6
do. do. Pref.	10	6	6	11½	—	5 9 1
Great Northern Tel.	10	20	20	34½	—	... ...
Indo-European	25	10	10	54½	+3	*4 11 9
Marconi	10/-	5	*10	8 1/16	+1/16	... ...
Marconi-Marine	1	8½	12½	8⅝	+⅛	3 9 1
Oriental Telephone Ord.	1	12	12	3	+1/16	... ...
United R. Plate Tel.	5	8	8	12½	—	3 4 0
Western Telegraph	10	10	10	27½	+¾	3 13 6

*Interim.

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	5½	8⅝	—	7 11 9
do. do. 2nd. Pref. ...	5	6	6	3 3/32	+⅛	3 8 6
do. do. 5% Deb. ...	Stock	5	5	77	—½	6 9 10
British Electric Traction Def. Ord.	,,	—	—	775	+75	... ...
do. do. Pref. Ord.	,,	8	8	125	+1	6 8 0
Brazil Traction	100	6	7	81½	—1	2 9 1
Brit. Colombia Elec. Rly. Pcs. ...	Stock	5	5	95½	—	5 4 7
London & Sub. Trac. 5% Pref. ...	1	Nil	Nil	13/-	—	... ...
London United Tram Deb. ...	Stock	4	4	61	—	6 11 4
Mexico Trams, 5% Bonds	—	5	5	80	+1	6 5 0
Mexican Light Common	100	Nil	Nil	84½	—	... ...
do. 7% Pref.	100	Nil	7	76½	—	9 3 0
do. 1st Bonds	—	5	5	79	—	6 6 7
Yorkshire (West Riding)	1	Nil	Nil	5/-	—	... —

MANUFACTURING COMPANIES.

Babcock & Wilcox	1	18	15	3 15/16	+1/16	*4 4 9
British Aluminium Ord.	1	10	10	47/6	—9d.	*4 4 2
British Elec. Transformer Pref....	1	7	7	15	—	9 6 8
British Insulated Ord.	1	15	15	4 3/32	+⅛	3 6 0
Brush Ord.	1	10	10	28/9	—	6 19 2
Callenders	1	15	15	4¼	—	3 9 10
do 6½% Pref.	1	6½	6½	1¼	—	5 4 0
Crompton Parkinson Ord.... ...	5/-	—	—	19/6	—	... ...
do. 8% Pref.	1	—	8	25/9	—	6 4 3
Edison-Swan 1st. Pref.	1	7½	7½	25/9	—	5 16 6
do. 5% Deb.	Stock	5	5	86½	—	5 15 7
Electric Construction	1	7½	7½	26/9	—	5 12 1
Enfield Cable Ord.	1	20	20	5 5/16	—	3 15 6
English Electric	1	Nil	Nil	8/9	—	... ...
do. do. Pref	1	8	Nil	10/-	—	... ...
Gen. Elec. Pref.	1	6½	6½	24/6	+1/-	5 6 1
do. Ord.	1	7½	10	8½	+1/16	3 3 0
Henley	1	25	25	5¾	—	4 5 0
do. 4½% Pref.	5	4½	4½	4¼	—	5 6 0
India-Rubber	1	Nil	Nil	11/3	—	... ...
Johnson & Phillips	1	12½	10	38/3	—	5 10 3
Met.-Vickers Ord.	1	8	6	35/-	—	... ...
do. Pref.	1	8	8	2¾	—	5 16 5
Siemens Ord.	1	7½	7½	30/-	—	5 0 0
Telegraph Construction	12	10	10	25	—	*4 14 6

*Dividends paid free of Income Tax.

Electrical Exports of the United States.

Figures for 1926 and 1927 Compared.

THE following figures, showing the exports of electrical machinery and apparatus from the United States and the principal countries of destination in 1927, are taken from the recently-issued annual statistics of American trade. The comparative figures for 1926 have been added and notes of any increases or decreases given.

According to the official statistics the total values in thousands of dollars of the exports of electrical machinery and apparatus since 1922 have been as follows:—1922, 53,147; 1923, 59,927; 1924, 69,828; 1925, 73,790; 1926, 84,226; 1927, 84,610.

Insulated wires and cables, although shown below, are not classed in the United States statistics as electrical goods.

	1926. Thous. $	1927. Thous. $	Inc. or dec. Thous. $
Generators, d.c., under 500 kW—			
Total	960	871	– 89
To France	21	8	– 13
,, Canada	298	296	– 2
,, Mexico	89	60	– 29
,, Colombia	36	55	+ 19
,, Venezuela	43	31	– 12
,, China	12	11	– 1
,, Japan	19	31	+ 12
,, Australia	76	32	– 44
,, Cuba	34	55	+ 21
,, Brazil	64	28	– 36
,, Russia	6	17	+ 11
,, S. Africa	13	15	+ 2
Generators, d.c., 500 kW and over—			
Total	455	649	+ 194
To Canada	82	14	– 68
,, Cuba	10	19	+ 9
,, Brazil	12	225	+ 213
,, Chile	126	134	+ 8
,, Japan	123	75	– 48
,, Mexico	11	88	+ 77
,, Argentina	14	26	+ 12
,, New Zealand	—	21	+ 21
Generators, a.c., under 2,000 kVA—			
Total	188	170	– 18
To Canada	30	32	+ 2
,, Mexico	33	17	– 16
,, British South Africa	8	—	– 8
,, Colombia	12	33	+ 21
,, Cuba	2	7	+ 5
,, Philippine Islands	9	5	– 4
Generators, a.c., 2,000 kVA and over—			
Total	1,273	1,098	– 175
To Spain	80	—	– 80
,, Mexico	39	46	+ 7
,, Brazil	141	21	– 120
,, China	—	22	+ 22
,, Japan	604	899	+ 295
,, India	41	—	– 41
,, Chile	352	—	– 352
,, Canada	—	29	+ 29
Steam turbine generator sets—			
Total	920	1,822	+ 902
To Mexico	125	97	– 28
,, Cuba	108	105	– 3
,, Japan	355	45	– 310
,, Brazil	13	28	+ 15
,, Canada	111	106	– 5
,, Chile	224	20	– 204
,, Java	94	13	– 81
,, Argentina	11	943	+ 932
,, Australia	10	28	+ 18
Self-contained lighting outfits—			
Total	1,151	1,340	+ 189
To Spain	13	31	+ 18
,, Great Britain	128	122	– 6
,, Mexico	25	56	+ 31
,, Argentina	158	218	+ 60
,, Colombia	21	44	+ 23
,, Cuba	5	16	+ 11
,, Uruguay	30	32	+ 2
,, India	25	19	– 6
,, Australia	159	211	+ 52
,, British South Africa	106	70	– 36
Power transformers—			
Total	2,231	1,556	– 675
To Cuba	40	28	– 12
,, Canada	11	46	+ 35
,, Mexico	176	211	+ 35
,, Brazil	191	183	– 8
,, Chile	400	56	– 344
,, India	128	7	– 121
,, China	5	20	+ 15
,, Japan	888	364	– 524
,, Australia	48	45	– 3
,, Spain	5	110	+ 105
,, Russia	10	104	+ 94
Other transformers—			
Total	1,266	1,051	– 215
Accessories and parts for generators—			
Total	920	1,137	+ 217
Rectifiers, double current, and motor generators, dynamotors, synchronous and other convertors—			
Total	1,557	1,729	+ 172
To France	50	12	– 38
,, Great Britain	37	44	+ 7
,, Canada	220	375	+ 155
,, Mexico	41	35	– 6
,, Chile	318	144	– 174
,, India	36	35	– 1
,, Japan	313	299	– 14
,, Australia	144	184	+ 40
,, Spain	21	58	+ 37
,, Brazil	75	106	+ 31
Switchboard panels, except telephone—			
Total	2,193	1,628	– 565
Switches and circuit breakers over 10 amp.—			
Total	2,618	1,987	– 631
Fuses and fuse blocks—			
Total	352	370	+ 18
Watt-hour and other measuring instruments—			
Total	493	419	– 74
To Canada	61	46	– 15
,, Mexico	57	25	– 32
,, Cuba	22	38	+ 16
,, Brazil	162	133	– 29
,, China	33	29	– 4
,, Japan	21	27	+ 6
,, Australia	15	13	– 2
Volt-, watt-, and ampere-meters, and other recording, &c., apparatus—			
Total	2,152	2,139	– 13
Lightning arrestors, choke coils, &c.—			
Total	709	726	+ 17
Motors, under 1 h.p.—			
Total	2,000	2,614	+ 614
To Holland	20	13	– 7
,, Spain	52	58	+ 6
,, Great Britain	361	544	+ 183
,, New Zealand	72	42	– 30
,, Canada	634	753	+ 119
,, Mexico	44	39	– 5
,, Argentina	88	101	+ 13
,, Japan	107	98	– 9
,, Australia	162	179	+ 17
Stationary motors, 1 to 200 h.p.—			
Total	3,207	3,068	– 139
To Spain	69	17	– 52
,, Great Britain	132	157	+ 25
,, Canada	611	783	+ 172
,, Mexico	220	246	+ 26
,, Cuba	137	148	+ 11
,, Brazil	84	98	+ 14
,, Chile	295	175	– 120
,, China	28	42	+ 14
,, Japan	113	83	– 30
,, Australia	186	137	– 49
,, British South Africa	97	76	– 21
,, Argentina	513	281	– 232

	1926. Thous. $	1927. Thous. $	Inc. or dec. Thous. $
Motors, over 200 h.p.—			
Total	884	402	− 482
To Canada	60	48	− 12
,, Mexico	47	29	− 18
,, Chile	244	13	− 231
,, Japan	128	22	− 106
,, British South Africa	10	7	− 3
,, France	10	10	—
,, Spain	40	2	− 38
,, Panama	82	32	− 50
,, Cuba	36	38	+ 2
,, Colombia	60	49	− 11
Railway motors—			
Total	1,126	915	− 211
To Canada	13	49	+ 36
,, Cuba	95	—	+ 95
,, Spain	49	90	+ 41
,, Mexico	4	1	− 3
,, Brazil	76	181	+ 105
,, Chile	66	3	− 63
,, Japan	175	264	+ 89
,, Australia	246	52	− 194
,, British South Africa	66	14	− 52
,, Colombia	52	36	− 16
,, Portugal	61	61	—
Starting and controlling equipment—			
Totals—			
For industrial motors	1,395	1,152	− 243
For electric railway and vehicle motors	203	247	+ 44
Accessories and parts for motors—			
Total	2,181	2,410	+ 229
Railway signals, switches, and attachments—			
Total	505	775	+ 270
To Canada	191	330	+ 139
,, Japan	42	160	+ 118
,, India	41	25	− 16
,, Chile	5	21	+ 16
,, Australia	86	44	− 42
,, Spain	10	81	+ 71
Insulating material—			
Total	1,380	1,361	− 19
To France	67	51	− 16
,, Great Britain	371	385	+ 14
,, Canada	273	366	+ 93
,, Japan	286	115	− 171
,, Australia	57	44	− 13
,, Italy	16	52	+ 36
Fans—			
Total	948	1,005	+ 57
To Canada	76	122	+ 46
,, Argentina	203	252	+ 49
,, China	119	72	− 47
,, British India	74	68	− 6
,, Australia	56	66	+ 10
,, Cuba	50	31	− 19
,, Mexico	45	50	+ 5
,, Great Britain	31	13	− 18
,, Japan	52	36	− 16
,, Hong-Kong	45	43	− 2
Heating and cooking apparatus—			
Total	1,722	1,558	− 164
To Great Britain	271	196	− 75
,, Canada	289	326	+ 37
,, Japan	62	62	—
,, Argentina	138	117	− 21
,, Australia	327	271	− 56
,, Mexico	85	77	− 8
,, Brazil	58	39	− 19
,, New Zealand	150	92	− 58
Motor-driven household devices—			
Total	1,744	2,312	+ 568
To Holland	86	88	+ 2
,, Great Britain	580	758	+ 178
,, Canada	255	427	+ 172
,, Japan	18	23	+ 5
,, Australia	336	395	+ 59
,, New Zealand	80	50	− 30
,, Belgium	39	62	+ 23
Industrial electric furnaces and ovens—			
Total	253	532	+ 279
Metal filament lamps—			
Total	1,603	1,538	− 65
To Canada	16	28	+ 12
,, Peru	25	24	− 1
,, Mexico	267	301	+ 34
,, Cuba	185	196	+ 11
,, Argentina	205	124	− 81
,, Brazil	44	50	+ 6
,, Australia	188	115	− 73
,, British South Africa	44	37	− 7
,, Chile	116	102	− 14

	1926. Thous. $	1927. Thous. $	Inc. or dec. Thous. $
Magnetos, sparking plugs, &c.—			
Total	1,904	2,006	+ 102
To Italy	102	121	+ 19
,, Great Britain	117	35	− 82
,, Canada	588	459	− 129
,, Argentina	81	82	+ 1
,, India	32	15	− 17
,, Japan	122	121	− 1
,, Australia	61	40	− 21
,, New Zealand	16	7	− 9
,, British South Africa	15	14	− 1
,, Mexico	29	29	—
Insulated wire and cable, iron or steel—			
Total	276	191	− 85
Insulated wire and cable, copper—			
Total	4,816	5,166	+ 350
To Great Britain	358	463	+ 105
,, Canada	565	573	+ 8
,, Mexico	479	506	+ 27
,, Cuba	602	776	+ 174
,, Brazil	314	566	+ 252
,, Chile	678	278	− 400
,, Japan	31	50	+ 19
Batteries, flashlight—			
Total	1,674	2,250	+ 576
To Mexico	148	122	− 26
,, Argentina	169	324	+ 155
,, India	307	292	− 15
,, Philippine Islands	202	217	+ 15
,, Australia	58	91	+ 33
,, New Zealand	66	74	+ 8
Batteries, other primary—			
Total	2,020	2,429	+ 409
To Norway	18	15	− 3
,, Great Britain	93	80	− 13
,, Canada	90	152	+ 62
,, Argentina	512	520	+ 8
,, Chile	35	43	+ 8
,, China	54	74	+ 20
,, Australia	411	702	+ 291
,, New Zealand	95	120	+ 25
,, British India	34	19	− 15
,, Brazil	85	79	− 6
,, Mexico	121	125	+ 4
,, Spain	13	25	+ 12
Batteries, storage—			
Total	3,443	3,673	+ 230
To Denmark	36	30	− 6
,, Great Britain	159	166	+ 7
,, Canada	293	299	+ 6
,, Mexico	149	120	− 29
,, Argentina	406	427	+ 21
,, Brazil	182	141	− 41
,, India	177	177	—
,, Australia	453	444	− 9
,, New Zealand	192	220	+ 28
,, South Africa	310	419	+ 109
,, Chile	111	142	+ 31
Metal conduit, outlet and switch boxes—			
Total	1,164	1,038	− 126
Telegraph apparatus—			
Total	1,018	1,037	+ 19
To Great Britain	218	60	− 158
,, Cuba	38	20	− 18
,, Canada	223	365	+ 142
,, Japan	43	99	+ 56
,, Argentina	6	10	+ 4
,, Newfoundland	91	8	− 83
,, Germany	88	62	− 26
,, Mexico	17	226	+ 209
Radio apparatus—			
Total	8,795	9,182	+ 387
Telephones, magneto—			
Total	105	356	− 81
Telephone, other—			
Total	332		
Telephone switchboards—			
Total	2,218	727	−1,491
Locomotives, electric railway—			
Total	1,841	690	−1,151
To Chile	301	260	− 41
,, Cuba	29	35	+ 6
,, Japan	928	—	− 928
,, Brazil	563	354	− 209
,, Canada	—	21	+ 21
Locomotives, electric, mining and industrial—			
Total	759	631	− 128
To Chile	285	244	− 41
,, Japan	45	37	− 8
,, Mexico	85	70	− 15
,, Australia	76	6	− 70
,, British South Africa	27	30	+ 3
,, Canada	26	74	+ 48
,, Soviet Russia in Europe	133	—	− 133

The E.C.A. Allied Associations.

Annual Dinner.

AS we mentioned in our last issue, the annual dinner of the Electrical Contractors' Association, Inc., N.E.C.T.A., Ltd., and the National Federated Electrical Association was held at the Savoy Hotel, London, on January 22nd.

The chairman was Mr. W. H. WALTON (president), and about 300 members and guests attended. The guests included notable men representing all branches of the electrical industry. After the loyal toasts, Col. WILFRID ASHLEY, M.P., Minister of Transport, proposed the toast of "The Allied Associations and Honorary Officials." In his speech Col. Ashley said that the contractors were members of one of the most prosperous major industries of the country. No other industry—not even the motor-car industry—had shown such rapid progress. In 1927 he believed that for the first time our exports of electrical goods and machinery exceeded those of either the United States or Germany. The existence of an industry run on such sound and progressive lines proved that Great Britain was still able to lead the world. The recent legislation had placed the electricity supply industry on a still firmer basis. The Central Electricity Board was to be congratulated upon the progress which it had made during its short term of life. Credit was also due to the Electricity Commissioners, and the Government might be given just a little credit for its foresight in making a survey prior to the 1926 Act, which had given the Commissioners and the Board something to work on. By 1940 the value of the electricity sold annually would be £44½ millions more than if the Act had not been passed. By the schemes already approved, 64 per cent. of the population of the country had been covered, and contracts valued at over £3¼ millions had been placed. In six months' time, in the Glasgow area at least, distinct benefits to the consumer would be apparent. The E.C.A. was doing a great deal to aid the progress of the industry; he particularly congratulated it upon its harmonious relationships with its employés. The Association was out to see that the consumer got good work for his money, and also that the contractor was properly remunerated for that good work. Reverting to the supply industry, Col. Ashley said that the towns could look after themselves, but special attention had to be given to electrical development in rural areas. Although it might be a long time before money invested in rural electrical development would receive a return, the country as a whole would be benefited by that development. He hoped that fruitful results would issue from the Electricity Commissioners' Conference on the subject. He also hoped that in the near future a body with which he was acquainted would be able to select one or two sample rural areas for development in an endeavour to discover whether the inhabitants of such areas really desired to have electricity. For the purposes of the test, houses would be wired for an annual payment, and appliances would be supplied on a hire or hire-purchase system. He believed that the rural areas wanted electricity. What had been done at Evesham and around Chester could not be beaten anywhere on the Continent. Only by intensive propaganda could success be brought to rural electrification, and in this direction contractors could assist.

In replying to the toast, Mr. WALTON said that the greatest work of the E.C.A. was the engendering of harmonious relations between the various sections of the industry. The apprenticeship scheme which it had introduced was not only necessary to the Association's progress, it was vital to the public welfare. It was the Association's aim to raise the standard of the labour and material used in installation work. He regretted that all sections of the industry did not realise the benefits of organisation which led to a lack of cohesion. Much of the domestic electrical work which was being carried out to-day was most unsatisfactory. It had to be borne in mind that lighting was not the question now; more and more apparatus was being placed in the hands of the public, and the quality of the work and the safety of appliances were most important subjects. Electricity was perfectly safe if properly installed, but positively dangerous installations and appliances were being given to the public. Some definite qualification or experience should be possessed by electrical contractors. The next best thing was a reasonable electrical code with penalties for non-compliance. The Government having interested itself in electricity supply, should take steps to ensure sound development from the user's point of view. The relations between supply engineers and contractors continued to develop on the most friendly lines, and more and more authorities had entered into assisted wiring contracts with E.C.A. members, to their mutual advantage.

Mr. T. E. ALGER (past president) proposed the toast of "The Guests." After referring to the presence of Col. Ashley, he said that Lt.-Col. Edgcumbe was not only an eminent engineer, he had also rendered distinguished service to the country. Mr. Wilmshurst was a member of a body whose aim was to bring electricity to everybody at a reasonable price; the speaker asked him to bear in mind the necessity for ensuring that installations were properly carried out. The smallest factory with lighting only was subject to severe regulations, but in the home there was no protection whatever of that kind. He concluded with a reference to Mr. Frank Hodges and other distinguished guests.

Lt.-Col. K. EDGCUMBE (president, I.E.E.), responding, said that his Institution had a high regard for the E.C.A. Electrical contractors were in direct contact with the public, upon whom the whole industry depended, and much was due to their energy and diplomacy. They had a great responsibility, and he was glad to see them insisting that installation work should be of a high quality. The public had to be persuaded that bad installations were dangerous without causing a panic. He said that although the Institution had drawn up wiring rules, it could not enforce them, but the contractors could adhere to them.

Mr. T. P. WILMSHURST (Electricity Commissioner) said that the Commissioners approved the work of the E.C.A. in endeavouring to raise the standard of installation work. His 30 years' experience as a supply engineer had taught him how much shoddy work was carried out. The rural field was almost untouched, but last year 70 Special Orders for country areas were made, and there were at present another 85 in hand. Overhead lines were essential if a cheap supply was to be given; farmers and landowners were now more willing to grant wayleaves.

Mr. FRANK HODGES (Central Electricity Board), who also responded, said that the Government was entitled to a small meed of praise for having lived while electricity had progressed so far. Historically, the Electricity Act of 1926 had its birth in a party which he would not name. All the same, electricity was far too big for politics. The Board had a definite objective, and it knew that it could only get there by all the technical and commercial interests in the industry working together. The fact remained that when electricity was being generated cheaply and abundantly it had to be brought into actual use through the instrumentality of the contractors.

Mr. WALTER RIGGS proposed the health of the chairman, and Mr. WALTON briefly responded.

During the evening songs, &c., were rendered by Miss Alice Lilley and Messrs. Robert Easton, Frederick Gregory, and Leonard Henry, with Mr. David Richards at the piano.

A Contractors' Dinner at Kidderminster.

There was a large attendance of electrical contractors at the Lion Hotel, Kidderminster, on January 24th, the occasion of the second annual dinner of the Circle of electrical contractors associated with the Shropshire, Worcestershire and Staffordshire Electric Power Co.

The Circle was inaugurated about 18 months ago in connection with the E.D.A. Campaign, and has been continued, having now a large membership of contractors from the area of over 1,800 square miles which is now supplied by the S.W.S. Co. The primary objects of the Circle are the promotion of closer relationships between the contractors and the supply undertaking, and the standardising of systems of supply and prices.

The company was presided over by Mr. J. T. H. Legge, chief engineer and manager of the company and chairman of the Circle, and the guests included the Mayor of Kidderminster, Mr. E. G. Eddy, and Lieut-Col. W. A. Vignoles, Director and Secretary of the British Electrical Development Association.

During the dinner music was provided by the company's loud-speaking equipment. Mr. Legge proposed the loyal toast, and Lieut.-Col. Vignoles the toast of "The Circle," which was responded to by Mr. W. Donovan, of Donovan and Co., Birmingham. Mr. R. French, Kidderminster proposed "The Visitors," and this was responded to by the Mayor of Kidderminster.

During the evening a presentation of a case of pipes was made to Mr. E. E. Hamar, commercial engineer of the company and hon. secretary of the Circle; and to Mr. C. C. McLeod, Circle Officer, a two-bottle tantalus was presented. An enjoyable concert programme followed, by the "Merry Optimists" party.

The Physical Society's Exhibition.—III.

Annual Display of Electrical Instruments and Scientific Apparatus.

Everett, Edgcumbe & Co., Ltd.

"Universal" moving-iron instruments introduced two years ago constituted a novelty in a.c. ammeters and voltmeters, not only as regards accuracy (being capable of sub-standard accuracy on a.c. and d.c.) but also in their immunity from the effects of changes of frequency, wave-form, and temperature; moreover, their power consumption was about one-fifth of that of the usual a.c. instruments. For certain purposes a demand has now arisen for instruments with an even smaller power consumption and suitable for still smaller current and voltage measurements; for this purpose a line of rectifier-operated moving-coil instruments consist of a specially adjusted moving-coil system, operated in conjunction with a series of four copper-oxide dry rectifiers (fig. 2) arranged in the form of a Wheatstone bridge. They are particularly suitable for a.c. measurements of small currents and low voltages, such as have hitherto necessitated the use of reflecting laboratory instruments. Almost any desired range can be provided: for example, ammeters which give a full-scale deflection with any current down to 1 mA and up to 500 mA, or, if used in conjunction with a small current transformer (which is self-contained in the case of portable instruments) up to hundreds of amperes. Voltmeters can be supplied to give full-scale deflection with 1 volt, and there is no upper limit.

Voltmeters and ammeters (other than those operated through current transformers) are equally available for use on direct current, being of the moving-coil pattern, dead-beat, high working forces (superior in this respect to the thermo-couple pattern) constancy of zero (as compared with the erratic zero of the hot-wire type) and an almost evenly divided scale throughout the useful range. The rectifier principle is also applicable to low consumption switchboard ammeters for use with bushing transformers, but in view of the low consumption and extreme dead-beatness of the latest pattern of Everett-Edgcumbe moving-iron ammeter, the extra expense and complication of a rectifier instrument is not often justified.

Bar type single-turn current transformer reliability, by the use of cores of nickel-iron alloy, has attained to very great precision, but the ever-increasing voltages in use in this country (for example, the 132 kV adopted for the "grid") make the currents to be dealt with extraordinarily small, so that the available ampere-turns of such transformers are so much reduced that it is essential to minimise the power consumption of the instruments connected to the transformer secondaries. To this end the company has introduced ammeters which consume only 0.5 VA at full-scale deflection and relays of all kinds consuming even less; by the use of such instruments, fitted with a ½-ampere current transformer secondary (in place of the usual 5-ampere one) it is possible to reduce the total burden on the current transformers to less than 2 VA, even with the very long connecting leads which are so often necessary in modern power stations. In this way, accurate single-turn current transformers are now available for full-load currents of 20 amperes, or less. The scale of these ammeters is so extremely open at the lower end (see fig. 3) that accurate reading of the high-voltage current is possible down to as little as 2 amperes. For the measurement of time intervals ranging from 1/20 second upwards, a meter (fig. 1) embodies a Warren synchronous motor, driving a pointer which is released and stopped by means of two solenoids, so that the rotation of the pointer shows the time interval between the closing (or opening) of the one circuit and of the other. The standard meter's pointer makes one revolution per second and an auxiliary pointer one revolution in 10 seconds; the dial is divided into 100 parts, so that 1/100 second can be read off. The construction is such that the time constants of the two solenoids are identical, so as to eliminate any error.

Another innovation is the metal-cased portable "Inkwell" grapher: whilst weighing exactly the same as the more usual wooden-cased instruments, it is eminently suitable for use in tropical climates, or wherever subjected to rough treatment, and the arrangement of carrying handle makes it easy to transport.

An interesting exhibit was a set of springs in various stages of manufacture: Messrs. Everett, Edgcumbe, are, we believe, the only instrument makers in this country who manufacture their own springs, a circumstance which enables them to keep exact control over this most vital part, for any departure from the predetermined sequence of heat treatment at once shows itself in a wandering zero, loss of constancy, and other defects. When it is mentioned that the thickness of many of the springs used is well under 0.0005 in. and that a spring 0.0005 in. thick exerts more than twice the torque of one 0.0004 in. thick, it will be realised to what a degree of accuracy it is necessary to work.

Fig. 1.—Time-interval Meter.

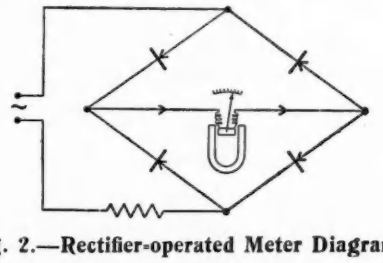


Fig. 2.—Rectifier-operated Meter Diagram.

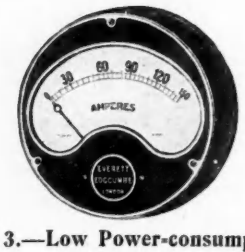


Fig. 3.—Low Power-consumption Ammeter.

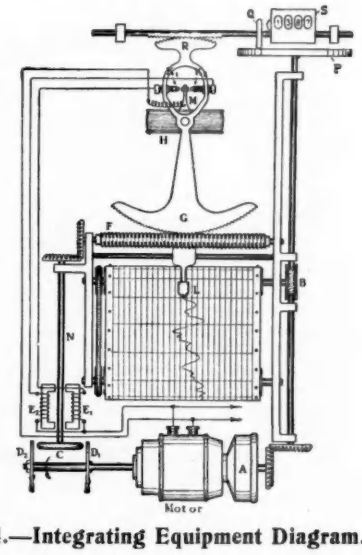


Fig. 4.—Integrating Equipment Diagram.

A recent addition to the train-testing relay recorders of current, voltage, speed, &c., for electric trains, consists in an integrating device suggested by Dr. G. V. Drysdale by means of which, not only are the quantities recorded graphically, but each is at the same time integrated throughout the journey, so that its average value can be at once determined. Fig. 4 shows the equipment diagrammatically, the lower portion representing the grapher and the upper part the integrating attachment. The counting train S is driven by a small friction wheel Q resting upon the driving disk P which is run at constant speed from the motor A and is so arranged that as the quantity to be measured increases in value the toothed sector R causes the wheel Q to traverse to the left; that is to say, further and further away from the centre of the driving disk P so that its speed is increased. In this way, the number of revolutions made by the integrating train S is exactly proportional to the product of the quantity to be measured into the distance moved by the chart (*i.e.*, the time); hence, the average value of the quantity measured can be obtained by simple division.

Electroflo Meters Co., Ltd.

For the control of high-temperature industrial heating a panel was arranged in four parts: associated with the double-pivoted pyrometer, essentially a high-resistance thermo-electric indicator with automatic cold junction temperature compensation, was control mechanism consisting of a depressor bar,

periodically raised and lowered by means of a Warren synchronous motor, causing contact to be made in one of two electric circuits, depending upon the position of the pointer, *i.e.*, the operating temperature. Assuming that the furnace is cold, the depressor arm bottom contact is made; then a mercury vacuum switch inside the indicator is tilted by the motor and a circuit is established through the relay coil, causing the mercury relay switch to establish circuit to the contactor coil, so that the furnace current is switched on. The mercury switch is then broken by the motor, which, an instant later, raises the depressor arm; the circuit through the relay coil is broken, but the current is maintained in the contactor circuit by means of a holding switch, also operated by the relay coil. The furnace temperature continues to rise until the indicator pointer is above the control index, when, on the depressor arm falling, the alternative top contact is made; the mercury switch is then tilted as before, and a circuit is established which shorts the relay coil, breaking the contactor coil circuit. When the furnace temperature drops, the indicator falls below the control index and the cycle of operation is repeated, the furnace being maintained at the determined temperature by the position of the control index. The mercury vacuum switch eliminates the possibility of arcing at the contact; the coil box, also mounted on the panel, causes the indicating pointer to deflect to the right of the control index in the event of the thermo-couple burning out, or becoming disconnected, which ensures that the electricity supply to the furnace is cut off, so that no damage occurs to the charge, or furnace. The time switch enables the current to be switched on at a predetermined time, so that the furnace will be at the required temperature when it is desired to commence processing; it can also shut down the furnace automatically.

An absorption-type CO_2 indicator and recorder, with complete independence of water, glassware, and rubber connections, is operated by a 1/20-h.p. motor, driving a spur gear pump which exerts a suction equivalent to 12 in. mercury: a continuous supply of gas is drawn to the instrument, a definite sample being sealed off and forced to flow 8 in. under a baffle plate in the solution chamber, so that all of the CO_2 is absorbed; the residual gas then passes into a final measuring chamber and causes a bell to rise and a recording pen to move across a chart. An alternative model was also shown whereby electrical transmitting mechanism is operated as the bell rises; instead of a pen and pointer moving across a chart and scale, an arm is caused to add or deduct resistance in an electrical circuit.

Record Electrical Co., Ltd.

A change-coil ammeter, similar to the volt-ammeter set exhibited last year, but with the voltmeter portion omitted, is useful for testing over a range of from 6 to 600 A in six consecutive steps, d.c. and a.c., at commercial frequencies. It weighs 9 lb., and is 10.5 by 8.5 by 5 in. in size, fitted with a carrying strap.

A water-level indicator consists of a variable inductance (preferable in some respects to variable resistance) operated by a float, the a.c. being rectified and measured by a d.c. moving-coil "Cirscale" instrument; one of the latter also forms part of a tester for detecting the acidity of liquids by electrical means.

Radio Communication Co., Ltd.

The type RA.76 radio direction finder exhibited is applicable to spark, i.c.w., c.w., and telephony transmission over a range of from 550 to 1,100 metres. The frame aerial winding is enclosed in a rectangular chromium-plated copper tube mounted on a substantial deck pedestal (overall height of 6 ft. 9 in.) which does not cause visual obstruction. An indicating scale of large diameter and the control wheel rotating the frame (mounted on an extension below the pedestal) can be fitted over the chart table if required. The whole is non-magnetic, enabling the set to be fitted in the neighbourhood of the standard compass when necessary. Correction of quadrantal error up to 20 degrees is applied automatically, the setting being adjusted on calibration of the set, while the simplified method of sense indication becomes part of the normal process of taking a bearing. The amplifier controls have been reduced to four only, consisting of a single knob for tuning over the whole wave-range, reaction adjustment for increasing sensitivity and c.w. reception, sense switch to give direction on the line of bearing, and an on-and-off switch. The amplifier is of the superheterodyne type with a high intermediate frequency of the order of 75 kc/s. and the circuit arrangement successfully overcomes any tendency towards interaction between the oscillatory circuits and the frame aerial. Five low-consumption valves are employed, comprising a detector-oscillator, two screened-grid intermediate-frequency amplifiers, one detector with reaction, and one note magnifier. Under normal conditions the width of the silence arc is a few degrees only, and bearings are obtained with an accuracy of one degree after a little practice in about five seconds.

Baird & Tatlock (London), Ltd.

Amongst physical, chemical, and biological apparatus improved photometric bench devices were noticed; also a valve oscillator designed by Mr. D. C. Henry for obtaining a.c. for electrolytic conductivity work; and a new pattern of muscle thermopile: wound on a silver frame which is insulated with bakelite, the thinness of this insulator increases the heat capacity of the "cold" junctions, and they do not readily become warmed up; the "hot" junctions have a very small heat capacity, however, as they are stretched across the frame and no insulator is in contact with them except the thin bakelite insulation. The thermo-element is mounted on an *all-metal* base, coated with bakelite, which facilitates both a uniform temperature, resulting in a stable zero, and quickness in settling down, *i.e.*, 15 *minutes*, compared with *two hours* in the case of the old type.

Bellingham & Stanley, Ltd.

A hand fluorescence lamp fitted with a simple arc lamp in an asbestos chimney, which carries a filter glass passing the nearer ultra-violet light, has been designed for examining substances and medical diagnosing.

Isenthal & Co., Ltd.

A large selection of various types of mercury switches capable of handling currents up to 30 amps., some being suitable for use on circuits up to 1,000 volts, was on view and inexpensive mercury switch relays. A new direct-reading voltmeter which can be made for voltages up to 500,000 volts, consists essentially of two condenser plates between which an electrostatic field is created, the effect of the field upon a light rotating vane being directly shown as a luminous line on a scale according to the distance apart of the condenser plates. The instrument can be calibrated for comparatively low voltages (say, 1 to 10,000 volts) and the calibration curve extended up to any desired voltage. The movement of the vane is practically aperiodic and without friction. The instrument is very suitable for research, being independent of frequency; it is also used in connection with therapeutic and diagnostic X-ray work.

H. Tinsley & Co.

This large exhibit included a new alternating-current potentiometer, of the pattern of Prof. Pederson, of Copenhagen, for the investigation of audio-frequency voltages, which has been made in the test disk form for the International Standard Corporation's development research laboratory at Hendon.

Mr. O. E. Malinverno.

Representing Messrs. S. A. Brevetti Arturo Perego, of Milan, Italy, he exhibited portable safety telephone apparatus for straight connection to lines running along 33,000-volt overhead power lines. Its characteristics are such as to overcome inductive and electrostatic disturbances reaching the telephone and, in the event of accidental contact with the power lines, to prevent dangerous potentials reaching the telephone, or the operator. Besides the usual components of an ordinary telephone apparatus, the wooden box contains also two aluminium arms with h.p. fuses and hooks for connection to the line, and a telephone transformer. An earthed aluminium shield separates the primary coils from the secondary coil and also encloses both primary and secondary; the insulation between primary and earth, and between secondary and earth, stands a test of 30,000 volts.

Venner Time Switches, Ltd.

This exhibit consisted largely of time switches for widely different applications: for street and shop-window lighting, two-rate meter and maximum demand control, both electrically and hand-wound, with a neat solar device on some of the electrically-wound switches. An impressive instrument was a large current oil-break switch, which can be supplied to handle currents of 1,000 amperes at 600 volts, or up to 6,600 volts. The automatic time switch and coder adopted by Trinity House for Marconi direction-finding wireless beam lighthouses was arranged to repeat a given code station call in Morse by flashing lamps. Thermostats for the control of electric water heaters, stop watches reading to two decimal places of a second, the Venner-Dyke buoy lamp for 18 nights' operation consecutively without attention, for use on ocean cable repairs and maintenance, and the Venner C. & S. electrically-operated remote boiler water level indicator formed the remainder of the exhibit.

Research Section.

In the research and experimental section of the exhibition the British Research Association for the Woollen and Worsted Industries showed a photo-electric yarn-levelness tester. The British Thomson-Houston Co., Ltd., displayed apparatus for tracing visually the characteristics of radio loud-speakers and amplifiers. The Cambridge Instrument Co., Ltd., indicated a method of controlling a high-voltage supply by thermionic valves; also electrically-welded vacuo-junction joints. The General Electric Co., Ltd., demonstrated practical applications of photo-electric cells, amongst many other exhibits, and the Gramophone Co., Ltd., electrical reproduction, &c., while Mr. H. F. T. Jarvis had a new thermostat control device on view. The Air Ministry displayed an electrical wind direction recorder, Mr. E. B. Moullin exhibited a high-frequency ammeter which can be calibrated with a steady current, Dr. J. H. Vincent explained experiments with magnetostrictive oscillations at audio and radio-frequencies, while the National Physical Laboratory had a large exhibit of radio and other apparatus.

Domestic Electrical Developments.

New Cooking, Heating, and Cleaning Devices for use in the Home.

A New Cooking Outfit.

In the new No. 46 model cooking cabinet, fig. 1, of the Jackson Electric Stove Co., Ltd., 143, Sloane Street, S.W.1, a particularly interesting feature is that the hob and oven top are on one level, thus giving greater hob space than is usual with electric table cookers. The cooker is strongly constructed in cast-iron and steel, and the oven is made in one piece, vitreous enamelled inside, with all its corners rounded.

Fig. 1.—A " Jackson " Cooking Cabinet.

The cabinet can be supplied with mottled-enamel, nickel-plating, and other finishes. The oven cooking space is 15½ in. high by 13¼ in. wide by 15½ in. deep. The hot cupboard measures approximately 22¼ in. wide by 17 in. deep by 8 in. high. The hob is fitted with two No. 86 hotplates and a grill, 10¼ in. by 8 in. The hotplates are loaded at 1.5 kW each, and the grill at 1.8 kW. The loading of the hot cupboard is 500 W. The various units are controlled by 3-heat switches mounted in the front of the range, and each circuit is fused. The overall dimensions of the cooker are: Width, 48 in.; depth, 23¼ in.; and height, 37 in., without splashplate.

New Polishing Irons.

The accompanying illustration, fig. 4, shows one of a range of

Fig. 2.—" Seymour " Safety Heater.

Fig. 4.—" Elect " Polishing Iron.

" Elect " polishing irons which have recently been introduced by the ELECTRIC HEATING CO., George Street, Croydon. Six sizes are available, varying in weight from 3 to 8 lb., and with loadings ranging from 250 W to 600 W. The face of the sole plate is rounded and highly polished, while the cover is finished in nickel plate and also highly polished. Good-quality ruby mica is used for the elements. At a small extra cost a special earthing connector is supplied.

The " Met.-Vick " Electric Wash Boiler.

This strongly-made appliance is illustrated in fig. 3. The outer casing and lid are of blue enamelled steel and it has a container of stout-gauge copper tinned inside, the whole being mounted on three legs. The boiler is equipped with a standard 3-kW immersion heater which is accommodated in a sump at the bottom of the pan, being protected from the clothes by a removable perforated cover. The tank has a capacity of 10

Fig. 3.—The " Met.-Vick " Wash Boiler.

gallons. If required, a tinned-copper spraying device can be provided. This forces a continuous supply of boiling soapy water through the clothes. The company considers that the boiler is particularly adapted to the requirements of hiring schemes.

A New Electric Heater.

The " Seymour " safety electric heater, fig. 2, an American production for which PROVINCIAL INCANDESCENT FITTINGS CO., LTD., Pifco House, 71, High Street, Manchester, have been appointed the sole sale concessionaires for Europe, probably represents a unique design for its class of apparatus. It is of simple construction, with a central enclosed element, and there is, it is claimed, a perfect diffusion of heat uniformly from all round the exterior. Other claims for the apparatus are that it is safe where there are children, and that it is suitable for warming children's food, shaving water, and so on; further, it is portable and can be used in any part of the

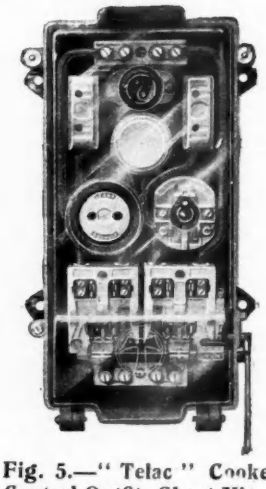


Fig. 5.—" Telac " Cooker Control Outfit, Ghost View.

house. The dimensions are 10 in. high and 9 in. in diameter. The loading is 660 W, and the element is suitable for pressures of from 200 V to 250 V. The heater can be supplied in either cream-, pink- or blue-enamelled finish.

Cooker Control Units.

Simple and efficient control equipment for domestic electrical cookers is, of course, necessary, and where provision is made for plugging-in such subsidiary apparatus as irons, kettles, cleaners, and so on, the appreciation of the consumers has led to increased business. In this connection the cooker control units recently introduced by Messrs. J. H. TUCKER & CO., LTD., King's Road, Tyseley, Birmingham, are of interest. These are available in two types, the enclosed ironclad pattern and the open type on a wood base board. The latter is very simply constructed, and is intended chiefly to provide a cheap control unit for small "baby" cookers in housing schemes, and so forth. The ironclad units each incorporate a 30-A main switch and provision for a pilot light. Normally the pilot lamp is inserted through a slot in the cover, and it may serve as an extra point for small appliances, where, of course, such a procedure is sanctioned by the supply authority. For cases in which the supply authorities object to a b.c. lampholder, on the ground that it may be used for lighting purposes off the power circuit, an Edison-screw lampholder can be substituted. In the unit S.9,000, fig. 5, a subsidiary circuit consisting of a 2- or 3-pin socket (5 A or 15 A capacity), protected by d.p. fuses and controlled by an earthed-pattern tumbler switch, is provided. In this unit the pilot circuit is also protected by a fuse, in case the lampholder is used to take off current by means of a b.c. adaptor for some portable appliance. In another unit, S.9,010, a sub-circuit is again provided by means of a socket, but the controlling tumbler switch is eliminated, as is also one of the protecting fuses and the fuse in the pilot circuit. Other control equipments introduced by the company may be taken as standard, but adaptions are regularly being made to meet supply companies' requirements. Provision can be made for the incorporation of a lamp inside the case, with a bull's-eye glass in the lid, if preferred.

Selected Radio-Telephone Apparatus.

Recent Developments and Improvements.

A Lightning Arrestor.

Marketed by E. R. MORTON, LTD., the "Wirt" lightning arrestor illustrated in fig. 1, seems to be a practical device. Through aerial and earth connections can be made with the

Fig. 1.—The "Wirt" Lightning Arrestor.

receiver without joints, which are liable to corrode; an air gap is sealed within a Bakelite moulding, which is provided with a large petticoat, so that it will retain its efficiency under adverse climatic conditions and provide a short, straight, path to earth for atmospheric discharges.

A Portable Receiver.

The new screen-grid portable receiver introduced by the GENERAL ELECTRIC CO., LTD., follows convention in being

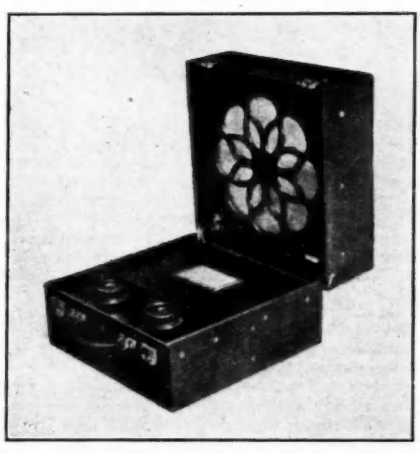


Fig. 2.—The "Gecophone" Portable Receiver.

divided into two sections, the main part housing the receiver and batteries, and the hinged lid the loud-speaker and frame aerial. Two tuning controls are provided, as well as a thumb-control reaction knob, while both long and short wavelength bands are covered, the change-over being effected by two switches, one on the left-hand side of the control panel and the other in the left-hand corner of the loud-speaker grille. Following the "Osram" screen-grid h.f. 2-volt valve, three successive valves comprise a detector and two stages of transformer-coupled low-frequency amplification, the last being a DEP.240 "super." The set is contained in a leatherette case (fig. 2), and its development has resulted in the production of a dependable non-spillable accumulator. Known as the 2-volt "Geeko" U-type, it has an actual capacity of 20 A, and, instead of the usual liquid electrolyte, a solid acid jelly surrounds the plates.

Improved "Exide DTG" Cell.

The "Exide DTG" cell is too widely known to need more than a very brief explanation of its design. Manufactured

Fig. 3.—Improved "Exide" Cell.

by the CHLORIDE ELECTRICAL STORAGE CO., LTD., it was developed to take the place of dry cells and primary batteries for prolonged small intermittent discharges, *e.g.*, bell work. The plates differ from ordinary comparatively thin plates, as they are massive slabs of active material enclosed in quite a slender antimonial lead frame, which construction permits of the plates standing idle for a protracted period (as much as two or three years it is claimed) between charges without undue sulphation. The advantages that the "DTG" cell has over dry and primary cells are its higher voltage per cell, stability

of voltage when current is taken from it, and particularly the fact that when eventually fully discharged a recharge will restore the cell to a condition practically equal to new. Although the earlier designs gave satisfaction, they are now made more attractive in appearance and stronger than before, to withstand vibration in transit. As indicated in fig. 3, the two terminals are quite dissimilar in colour and shape and in size of screw thread, which distinctions, with the addition of polarity signs on the lid and box, ought to provide effectively for the observant, the blind, and the heedless. The ebonite lid is moulded on to the terminal posts and the plate group bars, which project below the lid, enabling the individual positive and negative plates to be securely burned to convenient lug projections on the bars. The plates therefore hang from the lid, which is supported on ledges in the moulded-glass box, and receive the desired lateral support from ribs cast in the wall of the box, but they have freedom to expand in all directions. The moulded ebonite lid is so shaped that when in position on the box ledges it forms a convenient trough with the inner face of the wall of the box, and the trough is filled with a sealing compound. A combined filling aperture and ventilation exit is sealed with a mushroom headed soft india-rubber plug.

A Potential Divider.

The potential divider illustrated in fig. 4, the height of which is 4⅛ in. and overall diameter 3 in., has been designed by the Mullard Wireless Service Co., Ltd., to enable many different values of anode and grid-bias voltage to be obtained from the domestic mains following the smoothing circuit. Very low voltages are obtainable by adjustment of the five wander plugs round the base, the total resistance between tappings 1 to 10 being 9,000 ohms.

It should be noted that a condenser of at least 2 mF capacity must be connected between each positive anode terminal of the receiver and the negative anode terminal; not more than 250 volts (input) should be applied to the divider, and in no case should the sum of the currents (output) exceed 60 mA.

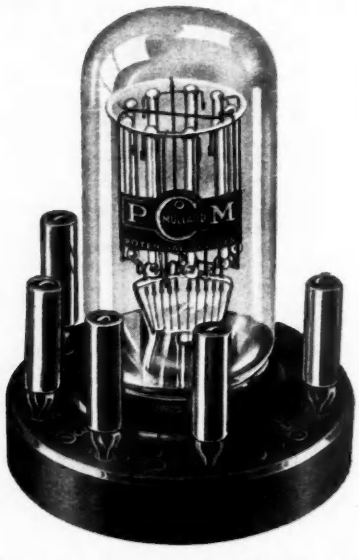


Fig. 4.—The P.M. Potential Divider.

Care must be exercised to prevent short circuits and avoid the possibility of receiving electric shocks.

The "Grid" Transmission System.

An outline of the chief constructional features of the 3-phase, 50-cycle, 132-kV (between phases) overhead lines being erected by the Central Electricity Board, the definite engineering costs included being reduced to a kVA basis to serve as a guide to the present economic position of e.h.p. systems in Great Britain.

By J. WRIGHT, M.I.E.E., and C. W. MARSHALL, B.Sc., M.I.E.E.

(*Extracts from paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE Electricity (Supply) Act, 1926, authorised the creation of the Central Electricity Board, to which was entrusted the construction of transmission lines and transforming stations required for interconnecting the power stations selected for supplying the national requirements of electrical energy and for providing supplies to undertakings which have no power stations. In almost all cases existing systems transmit large bulks of power from sources of energy to remote consuming points. In Great Britain the sources of energy are comparatively close to the users and to each other, and the function of the lines is to enable the most efficient power plant to operate at the highest load factor and to raise the plant utilisation factor by reducing the amount of spare plant required in individual stations. The interconnection of existing stations for this purpose has already been done on a comparatively large scale by many companies, so that the novelty of the grid scheme lies in its magnitude and the comparatively high voltage employed, rather than the introduction of any new principle.

The extent to which high-voltage transmission has been developed in other countries is illustrated by maps (in the original paper) of the main lines already constructed in France and Germany and a proposal for a national grid system in Spain. The comparative smallness of the British system,* as viewed from the standpoint of area of supply, is illustrated by a map of Great Britain superimposed on the area of a single large interconnected system in the United States. The systems in Europe, with the exception of Italy, are uniform in frequency and phase. France utilises 110-150 kV. The majority of German lines work at 110 kV, but the latest will operate at either 220 kV with an insulated neutral point, or 380 kV with the neutral point earthed. The Spanish scheme provides for a 220-kV ring main with 110-kV feeders and distributors. Most American systems operate at 60 cycles per second, although there is still a considerable amount of transmission at 25 and 50 cycles per second. The voltages used in America are very variable, the highest being 220 V. Lines operating at 132 kV are very extensively used in America; 30 companies operated lines of a total length of 3,824 miles in 1927, which represents an increase of 1,262 miles over that of 1926, and is a very definite indication that this voltage has proved satisfactory and successful in America. The complete British system will comprise 2,600 circuit miles of 132-kV overhead lines.

Overhead Lines.—The variation from normal voltage will not usually exceed ± 5 per cent. The voltage to earth will be maintained at a fixed maximum by directly earthing the neutral point of all transformers on the high-voltage side.

The choice of conductor material rested largely on the mechanical properties of the available metals. The difficulties in obtaining wayleaves and tower sites in towns made it essential to use spans of the maximum length. Steel-cored aluminium conductors are decidedly the best available in this respect, a further advantage being the protection afforded by the steel core against burning through in the event of a flash-over. The useful life of the conductors will very considerably exceed the 25 years called for by financial requirements. The standard line conductor consists of a central core of seven strands of galvanised-steel wire each 0.11 in. in diameter, surrounded by 30 strands of aluminium wire of the same diameter. The conductivity is equivalent to that of a copper conductor of 0.175 sq. in. cross-sectional area. The overall diameter is 0.77 in. The capacity of a single-circuit line is 50,000 kVA and the current corresponding to this at 132 kV is 219 amperes. The critical corona voltage under normal atmospheric conditions is approximately 184 kV. The earth conductor has seven steel and 12 aluminium strands, all 0.11 in. in diameter, serving as an electrostatic screen as well as providing a low-resistance path for returning fault current. Its characteristics are very different from those of the comparatively high-resistance steel wires usually employed on power lines, and, in view of the widely divergent opinions on the relative importance of the functions to be performed by earth wires, it will not be possible to demonstrate whether the extra expense is justified until actual experience has been obtained.

* ELEC. REV., January 25th, 1929, p. 168.

Towers.—The single- and double-circuit mild-steel towers† are designed for a normal span length of 900 ft., but angle towers are so designed that when used with corresponding maximum angles of deviation the sum of two adjacent spans may total 2,000 ft. under favourable ground-contour conditions. The clearance of the lowest conductor to earth at a temperature of 50 deg. C. is 22 ft., while over buildings the minimum clearance is 8 ft. The vertical distance between conductors is 12 ft., and the projected horizontal distance is 3 ft. The minimum normal clearance between live metal and tower is 3 ft. 6 in. under the worst conditions of line displacement.

Three types of foundations, *viz.*, excavated earth, concrete ball, and ordinary concrete, are used, depending on the nature of the subsoil and also relative costs. The concrete ball foundation is new to Great Britain, but it is widely used in America; it is made by drilling a cylindrical hole for each tower leg and expanding the lower end of the hole to a spherical form by exploding a charge of dynamite in it. The tower leg stubs are fitted into position by means of a template, and the cavities are filled in with concrete; the operation is simple, accurate and economical.

Loading.—The vertical load is made up of the weights of the conductors, together with a coating of ice of ½ in. radial thickness, and the weights of all insulators and fittings. The transverse load is that due to (1) a wind pressure of 8 lb. per sq. ft. on the whole projected area of all conductors when coated with ice, (2) the horizontal resultant of the conductor tensions, and (3) a wind pressure of 25 lb. per sq. ft. on 1¼ times the projected area of the members of one face of the towers. The longitudinal loadings are those impressed by the conductor tensions. These conditions are more severe than those called for in the recently revised Regulations of the Electricity Commissioners; under maximum loadings and broken-conductor conditions the factor of safety is 1.5.

Where concrete-ball or concrete-block foundations are used, the towers are earthed by means of galvanised-iron pipes 6 ft. long, 6 in. in diameter, and ¼ in. thick. As a final precaution, sample towers are tested to destruction.

Insulation and Fittings.—The decision to use the cap-and-pin type with ball-and-socket fittings does not preclude the use of such types as the Spring-ring, Jeffery-Dewitt, Hewlett, and Motor if, in the future, their technical and economical disabilities, relative to the type chosen, are removed. The maximum working load on a suspension insulator string is 4,000 lb. The relative position of the arcing rings and horns, together with the number of units forming an insulator string, is such as to give a minimum wet flash-over voltage of 340 kV. The normal voltage to earth is 76,000 and the factor of safety is therefore 4.5. Light horns, designed principally to improve the potential distribution on the insulator chains, are quite inadequate for dealing with power arcs; hence the decision to use horns and rings of very robust construction. Except that one additional unit per chain is used at tension points, the electrical insulation is uniform.

Mechanical Vibration.—There is considerable danger of trouble from mechanical vibration: breakage of conductors at tension clamps or suspension points has always shown that the metal has become crystalline. The usual cause of vibration is the action of wind at right angles to the conductor, and although the amplitude of such vibration is much smaller than that caused by release from ice loading, it is in reality much more dangerous. The conductor tension is the predominant factor in determining the frequency and amplitude of the vibration. That vibration may occur in a particular span and not in others which are seemingly identical is probably attributable to differences in towers or foundations; it is even possible that the sources of vibration are in the towers. If vibration which so arises is free to travel continuously over the conductors without being absorbed at tension points, or towers, that is probably the most general solution of the problem, but it appears to be exceptionally costly. So far as has been practicable, the grid lines have been arranged to be outside the danger zone, but arrangements have been made to measure and record the magnitude of vibration; it will therefore be possible to fit at danger points special anti-vibration devices should such prove necessary.

"Grid" Protective System.—Well-built high-voltage transmission lines are very free from operation troubles, in comparison with lower-voltage lines, because of their stronger mechanical construction and the very large spacing of the lines, which eliminates trouble due to birds, branches and (in some cases) lightning. Modern conditions, however, demand absolute continuity of supply, and it would appear that existing types of protective gear could safely be adopted for the grid; pilot-wire systems offered the best probability of obtaining rapid and sensitive discriminative protection, but their cost is not justifiable on long lines where other forms of gear can give almost as good results. Impedance or reactance relays are the only alternative at present available and are being used on the long sections of the Scottish lines to operate in case of excessive or incorrect flow of current. To guard against abnormal increases of potential due to lightning and abrupt load changes, it was finally decided to rely on a high-conductivity earth wire, provision of arcing rings and horns, reinforcement of transformer end-turn insulation and earthing the neutral point. No lightning arrestors will be used in the first instance, but klydonographs will be installed at specially exposed points in order to measure the voltages which are actually induced.

† ELEC. REV., October 28th, 1927, p. 751.

Inductive Interference.—From an electrical standpoint the most important subject on which complete information is not yet available is that of the effects produced on communication lines by the currents in power lines. The International Consultative Committee on Long-distance Telephone Communication calls for a coefficient of deformation of wave-form of not more than 5 per cent., and the alternators supplying power to the grid will fully meet this requirement; transformers operate at low flux density, so that they do not introduce appreciable wave-form distortion. The large line conductor diameter effectively prevents the generation of voltage harmonics by corona formation, and further measures which have been taken are triangular spacing and frequent transposition of the power lines. The distance between the grid lines and existing communication lines has been kept as great as possible and care is taken to avoid long parallel sections. Danger exists from electrostatic effects for a distance of approximately 400 yards on each side of the 132-kV lines. Where it is impossible to arrange for the desired amount of separation, it is necessary to ensure that the energy acting in the communication circuit will not exceed 0.02 joule.

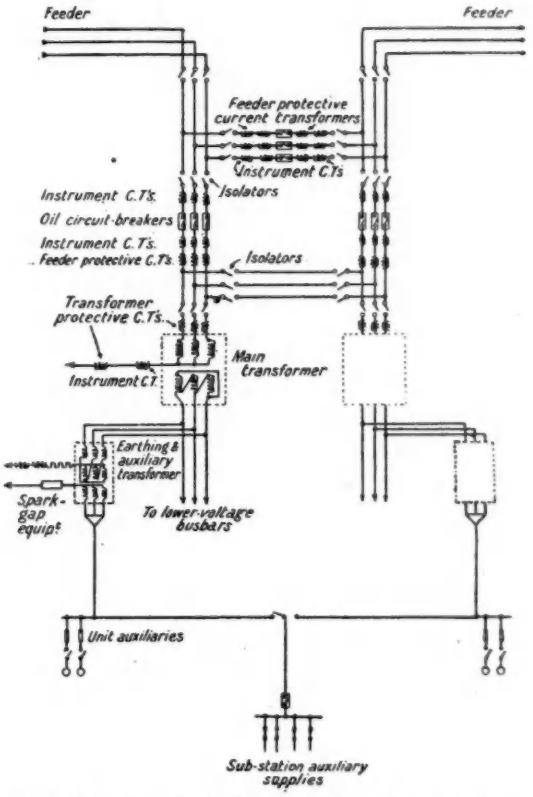


Fig. 1.—Diagram of Connections for 3 Circuit-breaker Sub-station.

The specific resistance of the earth is a predominant feature in determining the induced voltage, and it is also certain that the value chosen by Rüdenberg (5×10^{-14} C.G.S. units) gives too high voltages in most cases. Each country must determine the appropriate resistance for its own conditions, and it has been definitely decided that the earthed-neutral system is better than the insulated-neutral system as regards non-interference with communication circuits: the number of faults which occur on the power lines is reduced, selective protective apparatus is much more rapid and certain in action, so that a fault can be eliminated in a small fraction of a second, with the result that the duration of large earth currents, which are most to be feared, is very small. With fully-insulated neutral points there is also a tendency for faults to occur simultaneously on different phases at widely distant points on a system.

Sub-stations and Switchgear.—Six basic types of outdoor sub-stations were designed, fig. 1, as follows:—

L.N.E.	3 circuit breaker, non-extensible ...	low type.
H.N.E.	3 circuit breaker, non-extensible ...	high type.
L.E.	3 circuit breaker, extensible ...	low type.
H.E.	3 circuit breaker, extensible ...	high type.
L.D.B.	double busbar	low type.
H.D.B.	double busbar	high type.
C.	connections only between transformers and feeders.	

Type L.N.E. (fig. 2) provides switching arrangements for two 132-kV lines and two transformer banks, and it has a by-pass connection to enable each transformer bank to operate from either of the supply lines, normally kept open, and one transformer switch and the section switch must open automatically in the event of a fault occurring in either a line or a transformer. This arrangement utilises the minimum of apparatus consistent with rapid resumption of service after a fault. It has been chosen in preference to the more usual lay-out in which a circuit breaker is installed on each feeder, in addition to those included in the design

hand operation can be resorted to in the event of failure of the electrical gear

The isolating switches are of the rotating centre-pillar type, the three forming a 3-phase set being interconnected mechanically so that they can be operated simultaneously manually, but provision has been made for subsequent electrical control should it prove necessary. The isolating switches are interlocked with the main circuit breakers, and on double-busbar equipments it is impossible to make a connection to both busbars at the same time. Further interlocks prevent a transmission line earthing-switch being

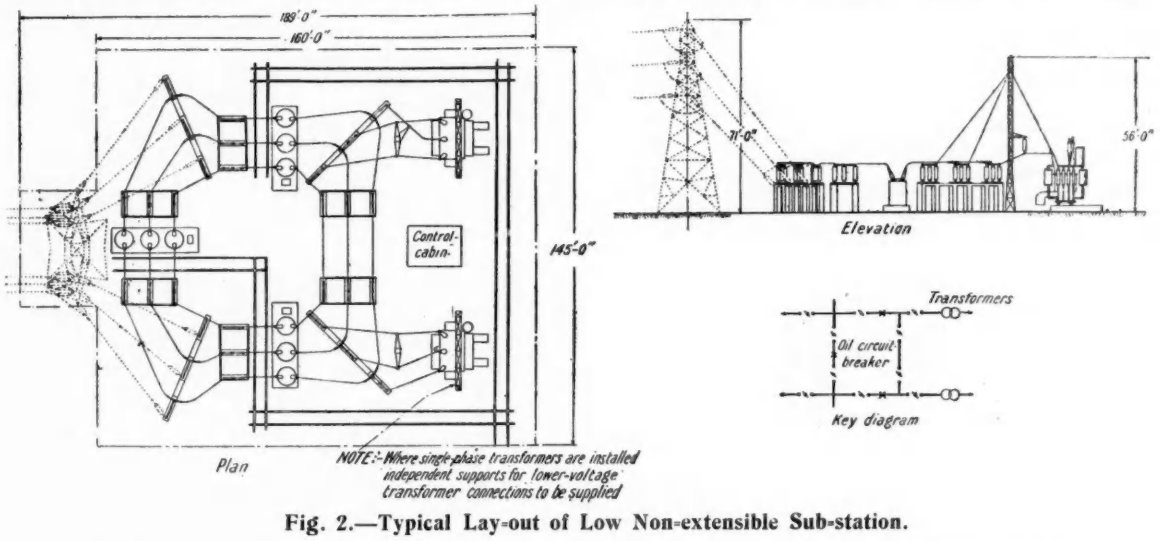


Fig. 2.—Typical Lay-out of Low Non-extensible Sub-station.

under consideration, because of the saving in cost, the reduction of maintenance charges, and the decreased number of danger points brought about by the simplification. Choice of design in any particular case depends entirely on site conditions: the H.D.B. arrangement (fig. 3) reduces the floor area required to the minimum, but involves the use of more structural steel and increases the height, so that inspection and maintenance are somewhat more difficult; it is only used where sufficient space for the L.D.B. type cannot be obtained.

The factor of safety of the complete structure is 2.5; the material is the same as that of the transmission-line towers, and the busbars are hollow tubes 0.9 in. in. diameter, the

opened, or closed, until the isolating switch on the line is open; or a by-pass switch being opened, or closed, unless the parallel circuit is complete.

The current transformers are of the single-turn bushing type, fitted over the insulators of the primary conductors, and the secondary windings can be left open-circuited on full primary load without being damaged. The standard full-load secondary current is 0.5 ampere. Potential transformers are connected to the lower-voltage side of the main transformers. The equivalent transformation ratio is 132,000/110 and the secondary winding is tapped in steps of 1.43 per cent. for a range of ± 10 per cent. to correspond to the tappings on the main transformers. In addition, the potential trans-

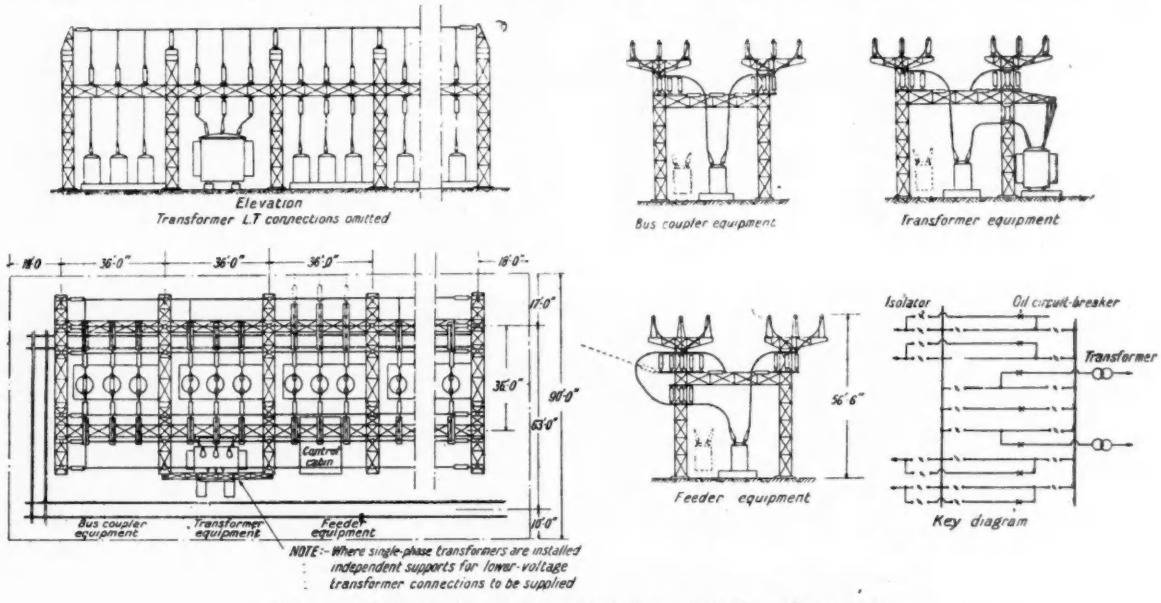


Fig. 3.—Typical Lay-out of High Double-busbar Sub-station.

copper cross-sectional area being 0.3 sq. in. The suspension insulators are identical with those on the overhead lines.

The main 132-kV circuit breakers, built up of single-phase sets, have a rated rupturing capacity of 1½ million kVA and their tanks are mild-steel cylinders with cast-steel covers of the same strength; the contacts are of the explosion-pot or multiple-break type. Each tank is fitted wih valves and screwed caps for coupling it to the oil-filtering and storage plant. The circuit breakers are normally operated from a 110-V storage battery, and they can be controlled locally, or from a remote point, but not from both points simultaneously;

formers are compensated to allow for the voltage-drop in the main transformers, so that their secondary voltage is a true measure of the line voltage.

The sub-station auxiliary services are supplied from tertiary windings on the earthing transformers. The standard voltage is 400/230 V, converted to 110 V direct current for battery charging (to operate the circuit breakers and to supply emergency lighting) by motor-generators.

A copper earth conductor of 0.25 sq. in. sectional area runs round each station and an earth plate is sunk at each corner of the earth-bar system; care is taken in all cases to ensure

that the earth in the vicinity of the plates can be kept permanently damp.

Operation of the Grid System.—In the earlier stages each section, such as Central Scotland, South-East England, or Central England, will function as a separate unit; district engineers will be in general control and all operations will be done by local operating engineers in accordance with their decisions. There will be a central point in each district from which all operations for that district will be carried out, or supervised; each district control engineer will have telephone communication with all power and transformer stations in his area. A special control room will be provided in each area, in which all the apparatus necessary for guiding the engineers will be located. The indications which are considered to be essential to the control engineer in a particular district are summarised briefly by giving the readings which are provided for him by all stations, as follows:—

(1) The operating positions (whether open or closed) of all circuit breakers, isolating and earthing switches.
(2) The transformation ratio in use on each transformer bank.
(3) The load which is being imported by or exported from each station, together with the current and power factor.
(4) The current, voltage, and power factor in each feeder circuit
(5) The plant in operation and available for operation.

The operating positions of the 132-kV line and sectioning circuit breakers will be transmitted automatically to the central control room, but no automatic indications of the isolating and earthing switches will be provided, as operation is purely a local matter, and any sudden abnormality is sufficiently indicated by the load variations accompanying it. The isolating switches will usually be operated only after communication with the control engineer, who will thereafter register their positions on his diagram. In the event of a local engineer being forced to operate such switches on his own initiative, due to emergency conditions, he will notify the control engineer of the alterations made. The load-indication instruments show the power and the wattless component of each circuit.

The transmission of automatic indications from remote points will be accomplished through telephone pilot wires in the sections of the grid which are at present being constructed; the possibilities of transmitting such indications by carrier-current systems are not being neglected. The function of the control engineers is to direct the operating engineers in the power stations and sub-stations, who will retain direct control of the plant, as at present. The operating records and statistics, as well as the meter readings required for accountancy purposes, will also be kept at the control rooms.

Transport.—It was decided for the time being to limit 3-phase transformers to 30,000 kVA capacity, to comply with the railway companies' requirements. Special wagons are being built to enable both the railway and road sections of the journeys to be made expeditiously.

Transformers.—All on the 132-kV system are for outdoor working; both core and shell types will be used, of 30,000 kVA or less of the 3-phase type, while those of higher capacity are made up from single-phase units. The standard capacities to be used are 7,500, 10,000, 15,000, 20,000, 30,000, 45,000, 60,000, and 75,000 kVA. Natural colling is used on the smallest, and larger ones have natural cooling up to half load or slightly more, while at higher loads forced air-blast cooling may be applied directly to the radiators on the transformer tanks, or to separate coolers with forced oil circulation. This is a definite departure from existing British practice and has marked advantages over water cooling. The auxiliary cooling plant operates only under emergency conditions and the risks due to corrosion or leakage are reduced.

The 132-kV windings are star-connected, the neutral point being connected permanently and directly to earth. The lower-voltage windings are delta-connected. In some cases the lower-voltage windings are in two parallel sections so as to provide two secondary pressures. The transformers have high impedance and their windings are very strongly constructed and supported. Adjustable clamps are provided to take up shrinkage of the insulating material. Voltage-regulating equipment can be operated under load for variations of ratio of ± 10 per cent. from normal in steps of not more than 1.43 per cent. One per cent. of the turns at each end of the phase windings is insulated to withstand full line voltage between turns for three seconds. The next 4 per cent. is graded so that at 5 per cent. of the number of turns from each end the insulation can withstand one-third of full line voltage for three seconds. The remainder of the winding is, except at tappings, insulated to withstand one-fifth of full line voltage for the same period. The insulation between turns of the tapped coils and 3 per cent. of the windings on each side can withstand one-third of the full line voltage between turns.

The terminal bushings are fitted with arc rings to allow of flashing-over without damage to the porcelain and conductors. Flexible connections are used between the bushings and the windings so as to avoid damage if there is any relative movement between them, and preference is not shown for either condenser-type or plain oil-filled bushings, but all types used in any particular schemes are mechanically interchangeable. An alarm device gives warning in the event of the winding temperature reaching 100 deg. C., and closes the tripping circuits of the breakers controlling the transformers if it rises more than 10 deg. C. above the temperature at which the alarm is given.

Except at three-shift power stations where permanent earthing facilities exist, a separate earthing transformer is provided for the secondary side of each 132-kV transformer; its main interconnected-star winding is directly connected to the lower-voltage side of the power transformer, and an auxiliary star-connected winding gives 400 volts, 3-phase, and 230 volts, single phase. The neutral point of the earthing transformer primary is earthed through a resistance. The earthing transformer can carry the full auxiliary load of the station auxiliary motors and lighting system continuously, and, in addition, any earth fault current for 15 seconds. The earth fault current is of the order of 400 to 900 amperes. The capacity of the auxiliary windings is 100 kVA, plus the kVA required for the station auxiliaries.

(To be concluded.)

Discussion in London..

Mr. W. B. WOODHOUSE thought the paper was a splendid account of the Central Electricity Board's work and it reflected great credit on British engineers; he hoped it would reflect equal credit on the manufacturers of the equipment when completed. It did not state how the "grid" had been designed, but the ruling principle seemed to be security, efficiency, and reasonable capital expenditure. It should be remembered that trivial causes might lead to serious disturbances: there were many reasons for adopting the 3-phase system, but they were not overwhelming and there might be cheaper methods. A 6-phase system would enable balanced protection to be employed, but six wires were too many and too costly, as stronger towers would be needed to resist the greater wind pressure. A 4-wire system might, however, be tried, and he had obtained the permission of the Electricity Commission to erect a section of such line experimentally. The use of 110 kV was commonplace in America; 200 kV was considered satisfactory there, and they regretted not having adopted 300 kV because the higher the pressure the less likely were the lines to be disturbed by lightning storms. The C.E. Board had been almost forced to use steel-cored aluminium lines for long spans; the weakest link in the chain was the switchgear, which appeared to be too costly and would not be really reliable.

Mr. R. O. KAPP pointed out the C.E. Board was doing more than merely follow the fashion; it had set the industry tasks which had been fulfilled well, and so set the fashion. The British "grid" had been designed as a whole, whereas those existing in other countries had grown bit by bit and were therefore uneconomical and difficult to operate with any degree of "loose coupling." The junctions of the ring mains would be "loose coupling" points and the rings themselves would always remain rings. The only thing that was certain about an urban system was that it would be inadequate a few years after its completion, but they need not be pessimistic about the "grid" in that respect, for only a small proportion of the total load would pass over it; it would work harder during the second and third years of its existence than during the fourth and fifth, and after that its growth would be due to the obsolescence of generating plant rather than increase of load.

Mr. A. PAGE remarked that the title of the paper might be extended to include the words "operation" and "maintenance." No time had been lost in presenting facts to the I.E.E. and through it (which was the right way) to the industry, and he hoped full advantage would be taken of the discussion so that the final "grid" would represent British engineering. Reliability received first consideration and involved reduction of corrosion, avoidance of insulator failure, selective protection, avoidance of interference with Post Office communication lines, and appearance acceptable to the public, all without extravagance in first cost. He paid tribute to the Post Office, railways, local authorities, and land owners for the public spirit they had shown. The electrical industry had been able to answer any call made upon it and all orders had been placed in Britain.

Mr. J. R. BEARD explained how the tops of the overhead-line towers had been modified to give them a tapering appearance, which improved them. The style and arrangement of the sub-stations, including the installation of few large, in preference to many small, transformers were the most preferable from the point of view of capital cost. He exhibited a lantern-slide map indicative of the progress made with the erection of the lines in South-East England, and said the fact that wayleaves for some 350 towers had already been obtained was a tribute to the energy of the C.E. Board's officers.

Mr. W. A. COATES considered it was not quite accurate to say that the manufacture of high-voltage equipment was breaking new ground. Soon after the 1914-18 war at least four makers commenced the development of such gear and it was available before the "grid" was decided upon; of course, it had since been improved. In the U.S.A. the low type of sub-station had not been quite satisfactory, as the forest of steel work around the high type of station protected it against atmospheric disturbance. The comparison of the cost of land with that of the steel structure of a double bus-bar station was not quite fair, for one insulator failure might cut across both bus-bars; such an accident could be avoided by erecting an addi-

tional steel member across the centre of the sub-station, which would absorb any saving of cost that might have been made.

Mr. R. BORLASE MATTHEWS pointed out that so far they had only heard rumours of what was being done, but the paper abolished all doubt that they had a system in advance of anything elsewhere, and it was always well to set the fashion. He was pleased to learn that ferro-concrete poles had, at least, received attention; also that protective pilot wires had not been adopted, for they might necessitate catenary suspension, which would add to the unsightliness of the lines. The paper did not include data relative to the secondary transmission system.

Captain J. M. DONALDSON (chairman), on account of the lateness of the hour, asked for other contributions to the discussion to be submitted in writing for publication in the I.E.E. *Journal*.

Mr. C. W. MARSHALL replied to the discussion, Mr. Johnston Wright having read the paper in abstract. The assumption that the national system would be loosely coupled was correct, local lines being more rigidly coupled, and the design was such that the series impedance of the transformers could be taken advantage of if necessary. He doubted whether the claims made for other than the 3-phase system would be forthcoming in practice; electrostatic dissymmetry was not so pronounced in the 3-phase case. In this country they had to contend with atmospheric pollution, rather than lightning.

Correspondence.

Correspondents should forward their communications as early as possible. No letter can be published unless we have the writer's name and address in our possession.

The Size of Generating Sets.

With reference to the recent announcements made in connection with the manufacture of generating sets of such large capacity as 67,250 kW, we should value the opinions of some of your readers on the advisability of the principle of "placing so many eggs in one basket."

Without in any way wishing to take any specific example, but rather to treat the principle of the matter, we consider one of the basic facts of continuity of supply to be—that the capacity of the largest set running on any system be governed by the ability of the remaining machines to take up its load in the event of its failure.

Whilst realising the economies to be effected in such directions as:—

(1) cost per kW of plant installed;
(2) operating costs;
(3) overall efficiency (at full load),

it must be admitted that no generating set yet made has been guaranteed against failure, and also that the loss of a 60,000-kW machine, to the comparatively small systems in this country, would, to say the least, upset the load-distribution, if not endanger the supply.

We repeat that further opinions on this subject, which to us is interesting and topical, would be valued.

H.².

January 24th, 1929.

[It should be borne in mind that when the "grid" is in operation, "small systems in this country" which are not connected with it will be much too small to contemplate the use of large generating sets; and the failure of a 60,000-kW set will not upset the grid, one of the principal functions of which is to render stand-by plant superfluous.—EDS. ELEC. REV.]

Lamp Trading.

Mr. R. E. A. Mallet mentions another instance of the trader being badly let down, and his remarks tally with our own experience. But it is on the lamp question that the trader stands most in need of fair play from the manufacturers—in this case a "ring."

I use the word "ring" with no malice aforethought, but simply through a desire to call a spade a spade. If no "ring" was involved there would be no occasion for comment because, then, being free to buy in the open market, traders would have an obvious and simple remedy.

Lamp business should be one of the "plums" reserved for the traders who have expended energy in the cultivation of it. The fact that anyone without any electrical knowledge can *now* hand lamps over the counter is no reason why any 'cute tradesman who has had no hand in the spade work of created demand should be invited to edge in for the profits.

I am optimistic enough to believe that the E.L.M.A. must see the need of giving fairer backing to the trade. I would like to challenge the E.L.M.A. to deny the accuracy of the following: That, despite its official definition of a retailer, any individual having any kind of business premises can be proposed by the E.L.M.A. representatives and thereby secure full reseller's discount by signing the agreement.

Surely, the E.L.M.A. has not such a narrow outlook as to imagine that Tom, Dick, and Harry side-line "merchants" are necessary to sell its wares?

I shudder at the prospect of the barber, with his razor on the upstroke, asking me: "How are you off for electric bulbs?"

J. H. Noble,

Director, THE ELECTRO-MECHANICAL SUPPLIES, LTD.

Coventry, *January 22nd*, 1929.

Load-Levelling.

Mr. W. Holmes, at the outset of his interesting paper on "Load-Levelling Relays," as reported in your last issue, mentions the change-circuit system as "one of the most interesting schemes yet put forward in a practical way." In the next sentence, however, this favourable comment is spoiled by the statement that "it needs additional mains and special gear at the receiving end."

May I point out that these are not characteristics peculiar to the change-circuit system; they apply to load-levelling operations of any kind, the only difference being that the change-circuit system gives a far higher return on the comparatively small additional capital entailed than any other system can. Moreover, the change-circuit system will meet the situation entirely, continuously and accurately dove to the two loads, *viz.*, the constant-pressure and the variable-pressure demands, under every variety of conditions.

While there is undoubtedly a field of application for the ingenious load-levelling relay of Messrs. Ferranti, neither it nor any other device of this character can automatically and continuously level up the load and increase the load factor in a degree comparable with that of the change-circuit system. Moreover, the latter system is the only one which is immune from the possibility of increasing the maximum demand on the generating plant, a most important point when purchasing in bulk, as many supply authorities will shortly be doing.

The problem can be looked at from the point of view of return on extra capital expended, or from that of public utility and service, with equally satisfactory results in favour of the change-circuit system of supplementary supply. As to cost of mains; in any event existing l.p. mains are too small to carry the extra loads which are inevitable on cultivation of the all-electric house scheme and kindred projects. Additional mains for these loads, if for constant-pressure supply, will cost substantially more than their equivalent for change-circuit supply, and they will not do the work so effectively, or cheaply, to either the consumer or the supply authority. Any station engineer who will take the trouble to go into the question of the alternative methods will verify these statements.

The variable-voltage meters mentioned by Mr. Holmes are not required on the change-circuit system, and the expensive item of meters for consumers' premises is saved. The heat-supply electric service is easily arranged by fixed payments per quarter, based on the size of the consumer's plant; thus, the consumer knows exactly what his liability is, and he gets his hot-water supply and cheap room heating automatically and without attention on his part, the simple apparatus being in the custody and under the control of the supply authority. The only meters required are the ordinary watt-hour meters on the primary side of the induction regulators in the sub-stations.

Geo. Wilkinson.

Harrogate, *January 28th*, 1929.

Gramophone Reproduction.

The contribution by Mr. E. W. Braendle in your last issue on the above subject is interesting, but may mislead readers in some respects. To save space in your "Correspondence" columns I propose to quote from the article and give my comments rather baldly: further explanation and proof could be given if space were available.

1. P. 140, first column: ". . . the audible quality of any tone depends entirely on the amplitude of the harmonics, not on relating phasing. . . ."

True for sustained notes of unchanging amplitude, but almost certainly untrue in other cases, which make up much of music.

2. End of p. 140 and beginning of p. 141, dealing with "pick-ups": "In any case, . . . the damage to the track is considerable; . . ."

The passage is not clear, but I read it as a statement that "damping" a pick-up is the cause of record wear. In actual fact, each of the three components of the mechanical impedance (elastic reactance, viscous resistance, and massive or inertia reactance) causes wear of a different part of the groove, and the question is much too complicated to be discussed in half a column. I hold that the suggested test by feeling a pick-up for "resilience" is quite useless. Your contributor does not mention electromagnetic damping, which is important. Working a pick-up into an unsuitable electrical load may upset it entirely.

3. P. 141, first column: ". . . the 'cutting-off' at this frequency (5,000 cycles) would not be noticed. . . ."

Obviously not, for in actual practice nothing is normally recorded above this frequency; the recorded range is only

150-4,500 cycles at full value, and the falling off is sharp at the upper end.

4. Same, next paragraph: your contributor vastly exaggerates the difficulty in designing gramophone amplifiers. Owing to the restricted frequency range (say, 100-5,000 cycles) they are much easier to design than broadcast radio receivers, which call for 40-8,000 cycles. I should certainly reject for radio work either of the designs he shows, though they would be fairly satisfactory for a gramophone.

5. P. 141, second column: "Loud-speakers of the moving-iron, or 'reed,' type have not, so far, seriously competed with the moving-coil pattern . . . " (either for power or frequency range, he explains).

I imagined it was common knowledge that my own firm's "Lion" moving-iron speaker has a power capacity equal to that of the few really first-class coil-drive types, and that the biggest musical experts have spent the last few months trying to decide which is really the better. In the long run it seems to have come down to a matter of personal taste: both the "Lion" and the first-class coil-drive speaker are practically perfect to all but the highly trained specialist's ear.

6. Same, next paragraph, on output transformers "... the transformer method is adopted as being the most satisfactory . . . ."

Your contributor does not mention the important advantage of a choke (or a *choke-fed* transformer) of allowing the large audio-frequency component of current in the last anode circuit to flow directly to the filament. This is essential with mains units of the normal rather high internal resistance, as otherwise there will be retroactive effects (positive or negative) which may completely ruin the frequency characteristics of the amplifier.

7. Generally, I am afraid that your contributor is not entirely up-to-date: much has been learned in the last year or two by those directly engaged in the electrical reproduction of music.

P. K. Turner, M.I.E.E.,
Chief Radio Engineer,
GRAHAM AMPLION, LTD.

Slough, *January 26th*, 1929.

Cost of Running a Private Motor Car.

I should like to communicate with some fellow reader on the subject of what is a fair allowance to an employé of a firm who owns his own car and runs it for business purposes. It is assumed that the cost of a new car is £275 and that he runs 10,000 business miles in an industrial area per annum, and that the car is in use on the firm's business for 5 days each week.

F. J.

January 28th, 1929.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1927.

20,692. "Electric arc lamps." Siemens-Schuckertwerke Akt. Ges., O. Krell, and H. Gerdien. August 5th, 1927. (303,534.)

24,938. "Electrical distribution boards and structures." G. Heptonstall and W. Shaw. September 22nd, 1927. (303,391.)

25,722. "Electric switchgear." British Thomson-Houston Co., Ltd., and E. D. Regis. September 29th, 1927. (303,427.)

25,849. "Electric switchgear." British Thomson-Houston Co., Ltd., and E. D. Regis. September 30th, 1927. (303,458.)

25,981. "Composite signalling conductors." Electrical Research Products, Inc. October 6th, 1926. (278,705.)

26,054. "Coil-winding machines." Hotpoint Electric Appliance Co., Ltd., E. R. Clarke, and W. J. Sims. October 3rd, 1927. (303,434.)

26,063. "Method of, and apparatus for, rendering an alternating-current differential wattmeter independent of frequency when employed as a resistance meter." J. Y. Johnson (I. G. Farbenindustrie Akt. Ges.). October 3rd, 1927. (303,460.)

26,158. "Electric combined control switches for automobile lighting, signalling, and horn-sounding." J. Bathgate. October 4th, 1927. (303,462.)

26,193. "Electrical transformers or couplers." F. W. Twort. October 4th, 1927. (Cognate application, 31,983/27.) (303,541.)

26,194. "Electric signalling devices." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. October 4th, 1927. (303,465.)

26,297. "Sparking plugs." R. G. L. Halford. October 5th, 1927. (303,549.)

26,301. "Electrical contact devices." Standard Telephones and Cables, Ltd. (Western Electric Co., Inc.). October 5th, 1927. (303,550.)

26,302. "Composite sets for telephone and telegraph lines." Standard Telephones & Cables, Ltd. (Western Electric Co., Inc.). October 5th, 1927. (303,551.)

26,303. "Automatic telephone systems." Standard Telephones & Cables, Ltd., and E. P. G. Wright. October 5th, 1927. (Addition to 268,802.) (303,552.)

26,315. "Variable-inductance devices." Igranic Electric Co., Ltd., and G. Holoway. October 5th, 1927. (303,553.)

26,369. "Electric inspection lamps for motor-vehicle use." L. T. Payne. October 5th, 1927. (303,555.)

26,421. "Load-discriminating systems for electric circuit breakers." A. Reyrolle & Co., Ltd., and R. Willoughby. October 6th, 1927. (303,558.)

26,487. "Composite electric conductors." W. E. Beatty (Bell Telephone Laboratories, Inc.). October 6th, 1927. (303,561.)

26,503. "Rectifiers for alternating currents." M. Singelmann. October 6th, 1926. (278,731.)

26,540. "Contacts for electric switches and circuit breakers." A. Reyrolle and Co., Ltd., and J. R. Smith. October 7th, 1927. (303,563.)

26,759. "Electric protective arrangements." A. Reyrolle & Co., Ltd., and H. Lyben. October 10th, 1927. (303,571.)

26,793. "Semi-automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd., and J. E. Ostline. October 10th, 1927. (303,575.)

27,095. "Starting device for electromotors equipped with a clutch." K. Kaisser. October 12th, 1927. (303,578.)

27,186. "Thermionic valves." M-O. Valve Co., Ltd., and J. W. Wigan. October 13th, 1927. (303,580.)

27,308. "Head lamps for motor road vehicles." Barker & Co. (Coachbuilders), Ltd., J. Ridlington, and W. T. G. Fensom. October 14th, 1927. (303,584.)

27,432. "Wireless receiving sets." S. G. S. Dicker (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). October 15th, 1927. (303,586.)

27,434. "Wireless receiving sets adapted for continuous or alternating-current feeding as desired." S. G. S. Dicker (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). October 15th, 1927. (303,587.)

28,314. "Combined electric turn-switch and wall plug." Z. B. Begg. November 3rd, 1926. (280,187.)

28,648. "Electric induction furnaces." M. Surjaninoff. October 30th, 1926. (279,883.)

28,764. "Method of, and means for, eliminating disturbing noises in the optical reproduction of sound records." Siemens & Halske Akt. Ges. April 9th, 1927. (288,225.)

28,766. "Electric heating elements." H. H. Berry. October 28th, 1927. (303,597.)

29,546. "Remote-control apparatus." Igranic Electric Co., Ltd., and A. H. Curtis. November 4th, 1927. (303,603.)

29,857. "Electrical heating units." R. A. F. Jackson and J. D. Place. November 8th, 1927. (303,606.)

30,077. "Wireless receiving circuits." Edison Swan Electric Co., Ltd., and L. H. Soundy. November 9th, 1927. (303,608.)

31,198. "Electric motor-control systems." General Electric Co., Ltd., and H. G. McClean. November 21st, 1927. (303,617.)

31,490. "Supporting means for electric lamp shades." E. L. Dunand. November 23rd, 1927. (303,620.)

32,569. "Electric arc lamps." Sun-Vi-Lite, Ltd., and R. J. Rawlings. December 2nd, 1927. (303,628.)

34,816. "Stereoscopic Röntgen ray fluoroscopy." F. Bornhardt. December 27th, 1926. (282,765.)

35,005. "Electric cooking vessels and coffee-making apparatus." E. R. Di Riccio. December 28th, 1926. (282,781.)

35,404. "Stereoscopic Röntgen ray fluoroscopy." F. Bornhardt. May 18th, 1927. (Addition to 282,765.) (290,619.)

1928.

2,035. "Electric conductor of solid cross-section and smooth surface." Metallbank und Metallurgische Ges. Akt. Ges., and J. Zagorski. January 31st 1928. (303,666.)

5,375. "Thermionic valve amplifying circuits." L. F. Douglass. February 20th, 1928. (303,681.)

5,557. "Automatic switches for battery-ignition engines." F. J. Stuart. February 22nd, 1928. (303,682.)

6,798. "Arrangement for detecting the direction of propagation of a current, particularly applicable to switching in telephone installations." C. J. A. Lange and L. J. E. Forest. March 5th, 1927. (286,607.)

7,355. "Insulator of the pintle type for five wires." F. Berg. March 9th, 1928. (303,689.)

7,725. "Boxes or containers for electrical accumulators." W. R. Edwards and R. Edwards & Co., Ltd. March 13th, 1928. (303,690.)

9,551. "Disconnecting switches for overhead electric lines." Aktiebolaget Bergslagens Gemensamma Kraftforvaltning. March 29th, 1927. (287,916.)

11,380. "Electric conductors of high negative temperature coefficient." H. Andre. June 17th, 1927. (Addition to 280,862.) (292,152.)

11,573. "Incandescent electric lamps having means for giving different degrees of luminous intensity." G. De Gasenko. May 31st, 1927. (291,372.)

14,628. "Remote control of electric power sub-stations." Associated Telephone & Telegraph Co. October 11th, 1926. (Divided application on 278,746.) (290,643.)

15,323. "Transformer for polyphase rectifiers." Maschinenfabrik Oerlikon. June 11th, 1927. (292,064.)

18,286. "Electric switching apparatus." International General Electric Co., Inc. June 23rd, 1927. (292,625.)

18,609. "Electric incandescent lamps." General Electric Co., Ltd. July 13th, 1927. (293,827.)

19,630. "Insulating blocks for the heating elements of electric heaters and the like." G. Pate and J. R. Laird. July 6th, 1928. (303,727.)

20,232. "High-frequency signalling systems." Marconi's Wireless Telegraph Co., Ltd. July 12th, 1927. (293,803.)

22,020. "Spark plug." G. A. Moller. July 30th, 1928. (303,729.)

22,446. "Coupling devices, suitable for use with rotatable frame aerials and the like." Telefunken Ges. für Drahtlose Telegraphie. August 3rd, 1927. (294,989.)

22,540. "Current-collectors for electric vehicles." G. Fischer. August 8th, 1927. (295,280.)

30,749. "Acoustic signalling devices." R. Bosch Akt. Ges. November 28th, 1927. (301,378.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from January 23rd:—

Dunco. No. 494,730. Class 6. Electric vacuum cleaning machines.—Sir Duncan Watson, trading as Duncan, Watson & Co., 61-62, Berners Street, W.1.

Gilectra. No. 497,438. Class 6. Electric turntable motors for gramophones.—Matthew Gill, Brunswick House, City Road, Manchester.

Radiographophone. No. 494,759. All goods in Class 8.—Columbia Graphophone Co., Ltd., 102-108, Clerkenwell Road, E.C.1.

Orchestrope. No. 497,243. Class 8. Combination kinematographic and sound reproducing apparatus.—"M.P.A." Wireless, Ltd., 62, Conduit Street, W.1.

Exide. No. 497,299. Class 8. Instruments and apparatus for use in radio-telegraphy and telephony, and instruments consisting of a radio receiving set and a gramophone.—Chloride Electrical Storage Co., Ltd., Clifton Junction, Manchester.

Power from Mud.

After prolonged experiments, a German company has purchased pumping plant and drying fields, at a cost of £250,000, with which to recover from the bed of the River Emscher, and to prepare for use as fuel, mud which is rich in combustible matter, washed down from the Westphalian coalfields. The *Morning Post* reports that the Rheinisch-Westfalisches Elektrizitätswerke has contracted for a supply of 100,000 tons of such fuel per annum, for use at an electric power station which is to be erected near the pumping station. As the removal of the mud from the bed of the river is necessary for the purpose of navigation, the scheme is doubly economical.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ALFRETON.—Housing scheme (46), for the U.D.C.; surveyor (returnable deposit of £5 5s.).

BARNSLEY.—52 houses, Burton Grange; borough engineer.

BEACONSFIELD.—Houses (22), for the U.D.C.; Blackwell and Meyer, builders, Bexley Heath.

BENSTEAD.—Nurses' home, Mental Hospital (£22,500); L.C.C. architect.

BIRMINGHAM.—Alterations to stores, infectious diseases hospital, Yardley Road, Little Bromwich (deposit £1 1s.); Dallas & Lloyd, architects, Cornwall Buildings, 45, Newhall Street.

BLANDFORD.—Houses (30), Milbourne St. Andrew, for E. R. Debenham.

BRIGHTON.—Elementary school, Hodsgrove Meadow (£30,000); Education Committee. Extensions, Phœnix brewery, Phœnix Place; Tamplin's Brewery, Ltd. 96 houses, Turners Allotments; borough engineer.

BURY (Lancs.).—Extensions, Anglo-Continental Grape Products, Ltd.; C. R. Cooper, architect, Market Street.

CHINGFORD.—Senior school for Essex Education Committee; director of education, Chelmsford.

CLAYBURY.—Nurses' home, Mental Hospital (£18,319); A. E. Symes, Ltd., Stratford.

COATBRIDGE.—Re-erection of business premises, Main Street, for A. M. Robb (£4,000).

COVENTRY.—Wesleyan halls; trustees, Warwick Lane Wesleyan Church.

DUKINFIELD.—Housing scheme, St. Luke's, for the T.C.; Halliday & Agate, architects, 14, John Dalton Street, Manchester (returnable deposit of £2 2s.).

DUMBARTONSHIRE.—Silk factory for British Silk Dyeing Co., London; the secretary.

DUNDEE.—Additions to slaughter houses; G. Baxter, city engineer, 91, Commercial Street.

FARNHAM (Surrey).—Additional 60 houses, for the R.D.C.; surveyor.

GLASGOW. — Extension at garage, Parkhead Tramway Depot, for Corporation (£15,000); city architect. Extension of warehouses for Messrs. Ewing & McIntosh, Sauchiehall Street; Mr. James Wright, jun., architect. Factory extensions; Templeton & Co., Craignestock Place. Alterations and improvements, Regent Flour Mills; Scottish Co-operative Wholesale Society, Ltd. Extensions, 41, Oswald Street; Stewarts & Lloyds, Ltd.

GUILSBOROUGH.—Reconstruction of Baptist Church and school; trustees.

HIGH WYCOMBE.—Chair factory, Copyground Lane, for White Bros.

HULL.—Extensions to Repertory Theatre, for the Little Theatre Co. (£12,000); E. C. Davies, architect, London.

HUYTON (St. Helens).—Additional 21 houses, for the U.D.C.; surveyor.

ILFRACOMBE.—Orchestral hall and public offices (£9,245), for the U.D.C.; surveyor.

IRLAM AND CADISHEAD.—Additional 75 houses, for the U.D.C.; surveyor.

IRTHLINGBOROUGH (Northants).—Factory for Maddocks & Co., leather manufacturers.

KEYNSHAM (Bristol).—School (280 places), for Gloucestershire E.C.; director of education, Gloucester.

KIDDERMINSTER.—Housing scheme (40), for the T.C.; J. Hawcroft, borough engineer (returnable deposit of £2 2s.). Showrooms, stores, and shed extensions, Exchange Street, for Brintons, Ltd., carpet manufacturers.

KIMBERWORTH.—Parochial Hall (£3,000), Col. J. E. Knight, architect, Rotherham.

KING'S LYNN.—Cinema at Hunstanton; Allflat & Courtney, Hill House, architects.

LEITH.—Re-erection (after fire), of mills, West Bowling Green Street, for R. F. Bell & Son (£5,000 to £7,000).

LIVERPOOL.—Extensive developments with ornamental gardens, &c., Otterspool; land steward, Municipal Buildings, Dale Street.

LONDON (Poplar, E.).—Additions, premises of Green & Weir, Ltd., Brunswick Street; T. Edge. School for 360 boys, South Poplar; St. Mary and St. Joseph's Catholic trustees.

LONDON (*continued*).

(Shoreditch, E.).—Reconstruction, Teale Street area; L.C.C. architect.

(Stepney, E.).—Hostel for women, Chicksand Street; Salvation Army.

(Hendon, N.W.).—Church, Eversfield Gardens; London Congregational Union.

(St. John's Wood, N.W.).—Buildings, Hanover Lodge, Park Road; Bostels, Ltd.

(St. Marylebone, N.W.).—Houses, Maida Vale; D. W. Beck.

(St. Pancras, N.W.).—Extensions, Royal Free Hospital, £100,000; governors.

(Fulham, S.W.).—44 tenements, Harwood Road, £34,000; L.C.C. architect.

MAIDSTONE.—Isolation hospital extensions, for the R.D.C.; surveyor.

MANCHESTER.—Hall, hotel and garage; Chas. Swain & Partners, architects, Manchester. Housing scheme (28), for Manchester Housing, 1926, Ltd.

NEWBURY.—Extensions, Money Memorial Museum; Captain Borgnis. Extensions, District Hospital, Andover Road; trustees.

NEWTON-IN-MAKERFIELD.—Secondary school (deposit (£2); Mr. Sarckinson, county architect, 16, Ribblesdale Place, Preston.

NORTHAMPTON.—Technical college and school, Kettering Road housing site, for the borough E.C.; A. C. Boyde, director of education.

NORTHFLEET.—Extensions, Crete Hall Road; W. T. Henley's Telegraph Works Co., Ltd.

ORMSKIRK.—Housing scheme (32), for the U.D.C.; H. W. Chadwick, surveyor (returnable deposit of £2 2s.).

OXFORD.—School (£65,112), for the City E.C.; Hinkins & Frewin, builders. Additional 238 houses, for the T.C.; borough surveyor.

PEMBURY (Tunbridge Wells).—Telephone exchange, for H.M. Office of Works; G. F. Penn, Ltd., builders.

PENN (Bucks.).—Smallpox hospital (£7,800), for the C.C.; county architect, Aylesbury.

ROTHWELL.—34 houses at Rothwell Haigh (17), Carlton (8), and Lofthouse (9); J. Southwart, surveyor to Council (deposit £1 1s.); tenders by February 11th to Mr. E. F. Moorhouse, clerk to Council.

ST. ASAPH (N. Wales).—Isolation hospital (£11,000), for Joint Hospital Board.

SHOREHAM (Sussex).—Additional 44 houses, for the U.D.C.; surveyor.

SHORT HEATH (Wolverhampton).—Houses (36), for the U.D.C.); J. Hicken & Son, builders, Willenhall.

SOUTHAMPTON.—Mental institution, Corporation Committee.

SOUTHEND-ON-SEA.—Cinema, Leigh Road and Maple Avenue, for the South Essex Cinema Syndicate.

STIRLING.—Adaptation of Royal Infirmary as education offices (£3,500); executive officer, Stirlingshire L.E.A.

STROUD (Glos.).—Housing scheme (40), for the U.D.C.; F. S. Cutler, surveyor (returnable deposit of £5).

TAUNTON.—Additional 100 houses, for the T.C.; borough surveyor. Extensions, High Street, for Hatchers, Ltd., drapers.

THORNE.—School, Goole Road (£34,000), for West Riding E.C.; Education architect, Wakefield.

TORQUAY.—Two blocks of flats, Westhill estate, for the T.C.; borough engineer (returnable deposit of £2 2s.).

WAKEFIELD.—Church, Byepass Road; Sir Chas. Nicholson and Messrs. Wrigley & Son. Seven shops and 14 garages, Dewsbury Road; city architect. Registry of Deeds (£57,658), for West Riding C.C.; county architect, Shire Hall.

WALTHAM CROSS.—Houses (50), Waltham House estate, for Biss Bros.

WOLVERHAMPTON.—Mission Hall, Low Hill, for Bushbury Church Council; vicar. X-Ray department, for the B.G.; clerk. Bank extensions, Kings Square; Lloyds Bank, Ltd. Warehouse, &c., Oxley Bank, for the Goodyear Tyre & Rubber Co., Ltd. Three-storey business store, Market Street, for Marks & Spencer, Ltd., London; W. J. Rawlins, architect.

WYKEN (Coventry).—School (300 places), for Warwickshire E.C.; director of education, Warwick.

YORK.—31 houses, adjoining Fifth Avenue (deposit £2 2s., completion by September 30th); F. W. Spurr, city engineer, Guildhall, York (February 4th).